THE

ELECTRICAL REVIEW.

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THE

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1900

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"FAIR PLAY'S A JEWEL!"

IF the Briton were given to boasting, he could find no better subject on which to pride himself than the undoubted probity and uprightness of our municipalities. Howbeit, these are but human, and therefore prone to err, and with the best intentions in the world they yet may be the instruments whereby grave injustices are perpetrated. A first offence of this description may be condoned; but what excuse can be found for a repetition of the same misdeed?

A case in point appears to be that of the Corporation of Bradford in connection with the contracts for the Bradford electric tramways.

The Corporation, acting apart from the local tramway company, some years ago decided to construct electric tramways, and issued specifications and conditions of tender. The specifications were prepared by the city surveyor and the electrical engineer to the Corporation, under whose superintendence the work was to be carried out to the entire satisfaction of the Corporation.

The conditions of tender were full of unnecessary details, and the specification was minute and presented several very curious features. Not only were the conditions and tests fully specified, but in some cases a given make of apparatus was compulsory. Thus special bonds 5¼ inches long and weighing 9 ozs. were specified, the trucks used had to be made by a designated manufacturer, and the car motors had to be G.E. type, actually manufactured by the General Electric Company, of America.

On the original specification (for G.E. apparatus) four tenders were received for the whole work, viz.:—

Messrs. Robert W. Blackwell & Co.	£16,460
The British Thomson-Houston Company, Limited	16,410
The Westinghouse Electric and Manufacturing Company	16,276
Messrs. Dick, Kerr & Co., Limited	15,067

In addition to the above tenders, however, the Westinghouse Company submitted an alternative offer, in which they substituted their own type of motor for the G.E. motor, cutting down the total price to £14,814. In spite of the specification, which explicitly stated that the motors must be made by the General Electric Company, of America, this alternative offer was accepted by the Corporation after a few minutes' deliberation.

In accordance with the usual municipal practice of accepting the lowest tender (where all comply with the specification and all tenderers are of well-known standing), Messrs. Dick, Kerr & Co. would have been given the contract. If the Corporation wished to save money, and decided to put their specification on one side, they should have called for open tenders under the new conditions, which gave the contractors a free hand. In that case Messrs. Dick, Kerr & Co. would have, in all probability, underbid the Westinghouse Company, just as they did on the close tender.

The Corporation asked for tenders for a certain thing, and

then seem to have accepted something else from a firm which went outside the specification.

Recently the Corporation desired to extend the tramways, and specifications were drawn up for that purpose. Tenders were received and contracts awarded, but, as in the previous instance, it appears that the Corporation has once more disregarded the terms of its own specifications and permitted the contractors to supply materials by no means conforming to the conditions laid down therein.

When the work of erection was commenced, the contractors, we are informed, brought forward suggestions to the effect that this and that item should be altered. Their proposals were accepted by the Tramways Committee, apparently on the advice of its engineers, and passed by the City Council. Singularly enough, these variations in every case involved the use of materials of inferior quality or strength compared with the terms of the specifications and the samples and drawings exhibited for the guidance of the firms tendering! It is almost superfluous to add that so far as we can ascertain no suggestion of a corresponding reduction of the contract price was put forward. Details of some of these alterations are given in the letter to the Bradford Corporation which we publish in another column.

The City Council, then, is in the position of having rejected the tender of its former contractors, amongst others, in favour of a lower one, "in the interests of the ratepayers;" while, when the work is in progress, it has, if our information is correct, permitted the contractors to depart from the specification on which the competition for the contract was based, and to follow their own devices and desires—in the interests of the *ratepayers?*

The injustice done by these proceedings, not only to the various tenderers, but also to the citizens of Bradford, is too obvious to require emphasis, and we cannot but think that such doings are calculated to bring down grave discredit upon municipal authorities; moreover, we have reason to believe that a similar state of things exists in several other of our cities.

The power to prevent these unfair practices rests in the hands of the engineers under whose supervision the works are carried out; we call upon them with confidence to secure for the various contractors that "Fair Play" which is the birthright of all Englishmen.

ELECTROLYTIC CORROSION.

A PAPER read before the American Institute of Electrical Engineers by Mr. S. Sheldon gives some interesting data as to the amount of damage done by underground currents when these are of considerable magnitude, and have been acting for a long time.

The borough of Brooklyn spreads over 60 square miles, and is covered with a network of trolley tracks. During the busiest hours about 1,100 cars run upon these tracks, and are supplied with current from seven power stations, furnishing in all 47,000 amperes. The currents return to the power houses partly by the bonded rails of the system, partly by the gas and water pipes, partly by the structure of the elevated railroad, and a small part by return feeders.

The difference of potential between the rails and the hydrants, and the rails and the gas mains, varies from a fraction of a volt to 25 volts. Between the two ends of the Brooklyn Bridge there has been a difference of potential of 20 volts. The difference of potential between a point on the boundary of a district and the ground in the immediate vicinity of the power-house supplying that district has been found to reach as high a value as 40 volts.

With such extraordinary P.D.'s impelling current through underground pipes and metallic structures like Brooklyn Bridge, and considering that the system has been in operation since 1892, the occurrence of considerable electrolytic corrosion is to be expected. This has, indeed, been found, though all pipes do not appear to be equally affected by it. In no case has an electrolytic corrosion of the water mains been discovered in the city, although many cases of corrosion of the service pipes have occurred. Gas mains have occasionally been damaged, and 38 gas service pipes on one block were completely destroyed in three years. The gas company claims that there has been an enormous increase of leakage since the introduction of electric traction in 1892. The sheathing of telephone and electric lighting cables have also suffered considerably from corrosion.

The apparent immunity of cast-iron mains was found to be due to the non-conducting silicious coating formed in casting, but when this film was once penetrated by a sufficiently high E.M.F. the rough sand-pocked surface became conducting throughout.

The author made measurements of the resistances between the rails and the hydrants of the water system, and found values varying from 10 to 35 ohms.

These figures show the vast amount of damage that might be done by unrestricted leakage currents in an extensive system of electric traction, and show the importance of insuring that the electric traction companies who are about to introduce this admirable system of transit on an extensive scale in this country, should not be allowed to discredit the system by wanton and avoidable damage to their neighbours' property. Under the Board of Trade Regulations up to a P.D. of 7 volts is permissible, but there is no need, if things are properly done, to have any appreciable amount of leakage. At Bristol the arrangements adopted, which were recently described in our columns, have reduced the P.D. to only 2 volts.

Municipal Trading.—There was issued on Saturday last a report of the Joint Select Committee of the House of Lords and the House of Commons, appointed some months ago to consider the principles which should govern powers given by Bills and Provisional Orders to municipal and other local authorities for industrial enterprises within or without the area of their jurisdiction. Although the Committee has met and "examined many witnesses," it has expressed the opinion that having been appointed at a comparatively late period in the session, it has not been possible to bring the inquiry to a satisfactory conclusion before Parliament rises. The recommendation, therefore, is that the Committee should be reappointed next session.

Shannon Electric Power Scheme.—The result of the recent inquiry shows very clearly how hard it will be to develop the resources of Ireland on modern principles. What applies to the Shannon can be made to apply to every other river in the country, with the result that none of them can be utilised. If the fisheries were in a really prosperous condition, the rejection of schemes like this could be regarded as immaterial to some extent; but where neither fisheries nor development schemes are allowed to work properly, it is hard to know what to do.

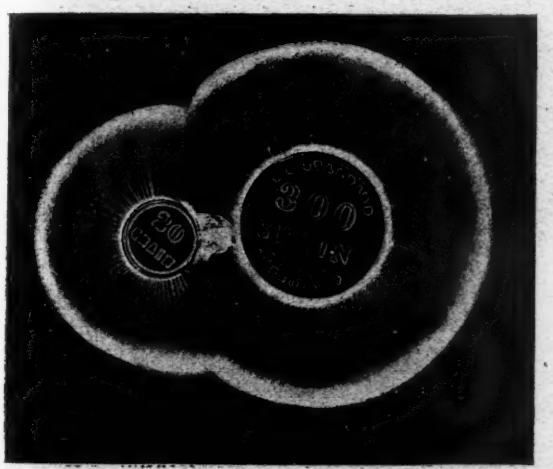
CURIOUS ELECTRO-PHOTOGRAPHIC EXPERIMENTS.

In a paper contributed to the *Transactions of the Academy of Science of St. Louis*, Vol. x., No. 6., Mr. Francis E. Nipher describes some remarkable experiments which will be of equal interest to the physicist and to the photographer.

It has long been known that an impression of a coin can be obtained by placing it on the sensitive surface of a photographic dry plate, and passing an electric discharge through it, then developing and fixing in the usual way. In all these experiments extraneous light must be carefully shut out from the plate.

Mr. Nipher despises these limitations. Before commencing his experiments, he prepares his photographic plates by exposing them to the light of an ordinary room for from one to nine days. The plate thus prepared is laid on a plate of glass, covering a plate of metal connected to one electrode of an influence machine. The coin or medal is connected to

Fig. 1.



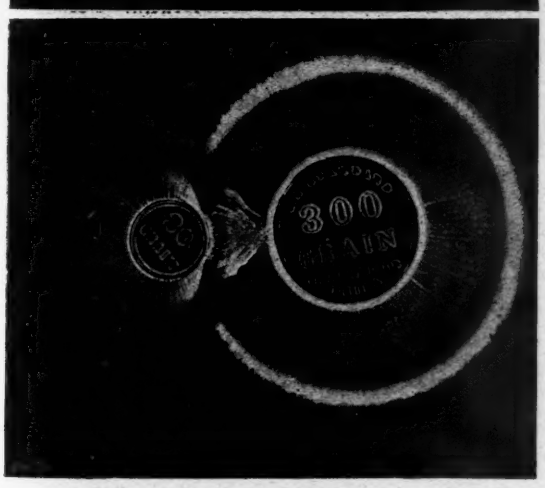


Fig. 2.

the other electrode, preferably through a spark gap. The exposure may be from 4 to 10 minutes. A much longer exposure reverses the picture, and gives a positive. The exposure should be in a darkened room, and the light from the spark should be kept from the plate by a screen. Light falling on the plate, while the electrical action is taking place, counteracts the electrical action in a very remarkable way. It is evident, therefore, that the time of exposure depends somewhat on the diffuse illumination in the room. A very dark room is not necessary.

In developing the picture, a cool and rather weak hydroquinone developer is used. The room should not be too dark during this operation. The best conditions are to be found in an ordinary dark room lighted by a single incandescent lamp. The light should be 5 or 6 feet away, and any tendency to fog is remedied by taking the plate nearer to the lamp. If already fogged, a plate may thus be cleared up in a very remarkable way. If the plate is too near the lamp during the whole time there is a loss of detail. By allowing the developing to begin 4 or 5 feet from the lamp, moving

Fig. 3.

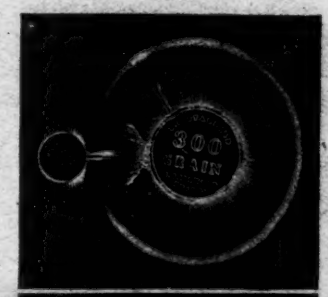


Fig. 4.

it up as necessity arises to within 2 or 3 inches, and with a cool and weak developer, the picture may be developed for an hour if desired. During this time the details are coming out with continually increasing sharpness.

Figs. 1, 2 and 3, are examples of electro-photographs of two medals, the larger one of which is connected to the machine through a spark gap; the smaller medal is charged by sparks passing from the larger. The figures show the effects with different intervals between the medals. A curious dark halo is observed round the pictures of the medals. In figs. 1, 2 and 3, the medal is connected to the anode. The picture obtained from the cathode is shown in fig. 4; the details in this case are much finer. The length of the spark gap also controls the character of the figures obtained. The oscillating spark discharge appears to be the important element rather than luminous or electrolytic action.

One of the most remarkable discoveries made by Mr. Nipher was the production, under certain conditions, of a slow moving ball discharge, showing many analogies with the mysterious ball lightning. While observing a plate exposed to the negative discharge, Mr. Nipher noticed a

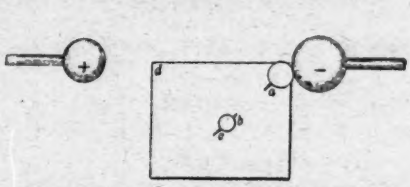


Fig. 5.—Diagram showing the Arrangement of Discharge in Pl. XV.

bright ball of light like a globule of molten metal roll slowly out from the medal across the plate. Its size appeared to be that of a pin's head, and it moved somewhat irregularly, and left a black narrow track in its wake. The discharges which had previously been in all directions around the medal were now all on the side occupied by the ball.

After many experiments, the best conditions for producing this ball discharge were discovered. The metal disc from which the discharge was to come was put in contact with the negative knob of the machine. The disc was armed with a radially placed needle point which touched the sensitive

film. No condenser was used in the machine, and the knobs were separated so that no visible discharge could take place between them. A needle point was also presented to the point on the surface of the film. A very effective device consists of two needles or pins, with their eye or head ends lashed

Fig. 6.

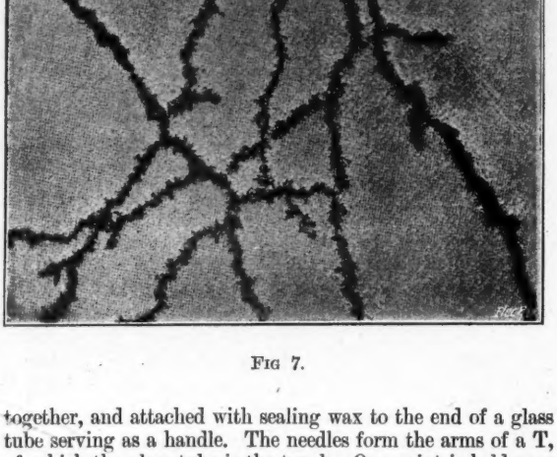


Fig 7.

together, and attached with sealing wax to the end of a glass tube serving as a handle. The needles form the arms of a T, of which the glass tube is the trunk. One point is held near the point from which the balls are to issue upon the film; the other point discharges into the air. This device has been called the "teaser." It seldom fails to bring the ball dis-

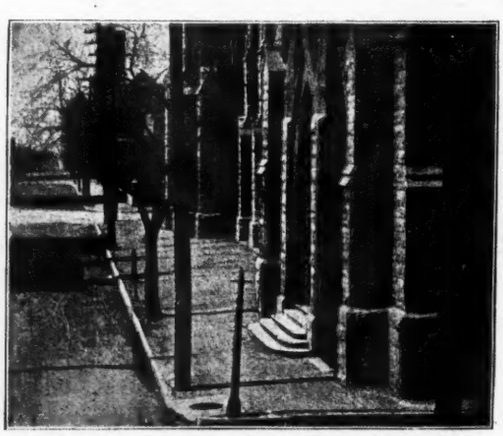


Fig. 8.

charge at once; the mark of a moistened pencil upon the film at the discharge point is sometimes needed. The teaser may also be used to lead the balls into abnormal paths upon the plate.

Fig. 5 shows the arrangement of an experiment for producing the ball discharge. A disc *b*, *c* was armed with two needle points, one of which was directed towards the point *a*, from which the ball discharges issue. The other was directed in an opposite direction. The positions of the knobs of the machine are shown in the cut. A very luminous ball discharge passed very slowly from *a* to *b*, requiring about a minute to traverse 1 inch. At *b* the luminosity disappeared, but it appeared at once at *c*, and drifted round towards the + knob. It reached the edge of the plate at *d*, and remained there for several minutes. A little rivulet of violet discharge passed along the whole length of the track, and was especially strong near *a*. When the machine was stopped, and the flow along this line ceased, it was found, on again starting the machine, that this track had ceased to act as a conductor. Another ball discharge appeared, but it found its way by a new path to *b* and *c*, and finally to the edge of the plate. The photograph produced on the plate is shown in fig. 6.

Mr. Nipher considers that these ball discharges are the result of a breaking down under electric stress of the medium composing the sensitive part of the film. The chemical action results in the formation of a track along which a discharge passes to feed the luminous nuclei. The phenomenon very much resembles ball lightning, and Mr. Nipher considers that the latter may also be due to the breaking down of the dielectric under great stress.

Fig. 7 is a reproduction of a portion of a negative, showing ball tracks magnified about 100 diameters.

Mr. Nipher's experiments in photographing the electric spark suggested to him to make experiments with over-exposed plates in X ray and ordinary photography, and some of the results he has obtained have apparently opened up a new field for photographers.

Light struck plates, which had been exposed for a day to diffuse daylight, were used to obtain X ray photographs. Singularly enough, these pictures were negatives when the plates were enclosed in black paper during the X ray treatment, and they were positives if they were exposed to the light while the X ray was acting. The advantage of being able to study an X ray picture during the operation of developing is very great, since the operation may then be pushed until the desired features have been brought out, and it may be arrested before they are obscured by over developing.

Mr. Nipher has also succeeded in modifying the exposures in ordinary photography, so that the plates can be developed in daylight. With exposures of from 1 to 3¼ hours' duration, the pictures developed in daylight with perfect clearness; they were, of course, positives. The pictures obtained by these long exposures show no trace of moving objects or of shadows.

An attempt was made to shorten the time of exposure, and still permit development in the light. The plate was first exposed to X rays for more than two hours, and then exposed to a street scene for 10 minutes. It was developed in the light. A very excellent photograph was obtained in this way, which, however, showed no trace of moving objects or shadows.

If a Röntgenised photographic plate whose proper time of exposure is 1½ to 2 seconds be exposed for about a minute and then developed in light, an excellent positive can be produced. Mr. Nipher did not succeed in every case; but one excellent result was obtained, which for richness of finish and perfect modulation of light and shade leaves nothing to be desired. This is reproduced in fig. 8.

A process for producing a positive picture directly has long been a desideratum with photographers. This discovery of Nipher's may supply what is wanted. Instead of ferrotype plates, the itinerant photographer will supply himself with a packet of Röntgenised plates. He will have to revert to the long exposures of the defunct wet process, but as a compensation for that, he will be able to dispense with a dark room and develop his plates in daylight.

Electrical Plant for Sydney.—The *North British Daily Mail* says that a Government Commissioner from Sydney, Australia, is at present in the States, and is expected to visit our shores to place large contracts for electric railway and lighting plant.

CURRENT SPECIFICATIONS.

XXIV—TORQUAY ELECTRIC LIGHTING.

SUMMARY.

Scope of Present Contract.—Supply and erection of extension plant as follows:—Section A: Two boilers. Section B: One 250-KW. and one 40-KW. steam alternator. Section C: Pipework, condenser, &c. Section D: Extensions to existing switchboard. Section E: Instruments. Section F: Foundations. Section G: Transformers.

Size and Type of Boilers.—Babcock & Wilcox or other approved type of water-tube boilers, each to evaporate 5,000 lbs. of water per hour, and to be suitable for a working pressure of 150 lbs. per square inch.

Superheaters.—Superheaters capable of superheating the steam 100° F. to be provided.

Type of Steam Engines.—For the 250-KW. set, Willans three-crank compound engine; for the 40-KW. set, Willans two-crank compound engine, to give above outputs with pressure of 130 lbs. per square inch.

Type of Alternators.—To be of "inductor" type, suitable for working in parallel with existing sets.

Range of Regulation.—Not to exceed 7½ per cent. on a circuit having a power factor of unity.

Permissible Temperature Rise.—Not to exceed 50° F. after six hours' full-load run, measured 15 minutes after stopping.

Type of Condenser.—An independent surface condenser with separate steam-driven air and circulating pumps, of 700 square feet cooling surface, to be provided. Air-pump to be of Edwards type.

Foundations.—To be of the special character specified on account of the site and character of ground.

Number of Transformers Required.—Four: one of 20 KW., three of 30 KW. output.

Specified Date.—Foundations to be completed and transformers delivered in *three* months, rest of work in *six* months from date of contract.

Penalty for Late Completion.—*One per cent.* of total contract sum per week.

Stipulations as to Removal of Foreman.—Satisfactory.

Stipulations as to Wages paid to Workmen.—Satisfactory.

Terms of Payment.—Eighty per cent. on completion of work, 20 per cent. six months afterwards.

Arbitration.—Limited in application. See comments below.

This contract refers to the first extension of plant at the Torquay central station, and affords another example of the tendency of public authorities to entrust the consulting work necessary when extension plant is required to their own engineer rather than the professional consultant responsible for the design of the original station. The specification is signed by Mr. P. Storey, the borough electrical engineer, and provides for the supply of new generating plant to the extent of 290 KW.

The new plant is specified to consist of "Inductor" type alternators direct coupled to "Willans" engines, the units being of 250 KW. and 40 KW. sizes respectively.

As regards technical details, the aim of the engineer has evidently been to extend at present on the general lines decided upon at first. The space available, however, is very limited, and soon it will be necessary to provide a larger station on a new and more suitable site.

The present generating station is situated near the sea, practically underneath the public building known as the Bath Saloon. When first decided upon, it was feared that there would be trouble from vibration, and the contractor was bound by stringent conditions, not only to provide special foundations, but to undertake to remove the plant to another site if found to be necessary.

The present plant is of double the size of that originally installed, and a somewhat similar clause as to responsibility of the contractor is inserted. Since, however, the contractor has no option either as to the position in which the new plants are to be erected, or as to the type of steam engine to be used, they should either limit the operation of this clause, or ask the makers of the engines to accept their full share.

As such a clause is an unusual one to insert in plant extension specifications, we reprint it in full:—

> The contractor will be required, in the case of Section B (for the supply of steam alternators), to enter into a proper guarantee that the plant supplied under this section shall not form or be a cause of any nuisance from vibration or noise to the adjoining or neighbouring houses or bath saloons. Should such nuisance arise within 12 months from the completion of the work, the contractor will be required forthwith to abate the same, and the contractor shall immediately take such steps, as in the opinion of the engineer shall be necessary, to effectually remedy any noise or vibration which may give rise to any complaint If, however, it be found impossible to abate such nuisance, *the Council shall be at liberty to require the contractor, at his own cost and expense, to remove the plant and machinery comprised under this section within a period of three months* from date of such requirement, which shall be in writing, and provide and fix such suitable plant which shall comply with the conditions as set forth.

It will be noticed that in this case, however, it is not removal of plant to another site, but removal of plant and supply of new plant which shall be in every way satisfactory which may be insisted upon. We trust that tenderers will satisfy themselves as to the risks incurred under this stipulation before signing the contract. As at present drafted it seems to place upon the contractor greater risks than the order warrants.

We notice that in the clause relating to penalty for late completion, the wording is such that the contractor for several sections is placed at a disadvantage, since the penalty for late completion of one section is to be calculated on the "gross sum payable to him under his contract," and not upon the sum payable for that particular section. Unless the Corporation are willing that a contractor should increase his tenders for separate sections if more than one is placed with him, the penalty ought to be calculated upon the value of the particular sections late.

That the Corporation have no such idea as a provision against the extra risk thus incurred by the contractor is manifest from the following clause:—

> The Council reserve to themselves the right of accepting or declining a tender for the whole or any one or more sections of the work. *Firms tendering must state what deduction may be made if two or more sections of the work be allotted to them.* The Council do not bind themselves to accept the lowest or any tender, nor will they be responsible for or pay for expenses or losses of any description which may be incurred by any firm tendering in the preparation of their tender. All tenders must be made on the prescribed form and must be complete in every particular.

The arbitration clause is very satisfactory. It reads:—

> If any dispute or difference *(exclusive of all questions within the powers of or which are to be determined by the engineer)* arise under this contract between the Council and the contractor upon any matter whatever arising out of this contract, such dispute or difference shall be referred to an arbitrator, and this contract shall for such purpose be a submission under the Arbitration Act, 1889.

When we examine the specification to find out what are the questions to be determined by the engineer, we find among them such clauses as the following:—

> *Should there be any doubt or obscurity* as to the meaning of any portion of the specification, plans, or general conditions, firms tendering must set forth the particulars thereof, and submit the same to the engineer, in order that any such doubt or obscurity may be removed before the acceptance of the contract. *If any such misunderstanding should arise during the progress of the works, the decision of the engineer as to the meaning of any dimension, clause, word, sentence, or otherwise, must be taken as final.*

The remaining conditions are fair, but we hope that tenderers will insist upon the insertion of fair arbitration claims in public contracts. In many cases, unless we are dealing with specifications prepared by consultants of proved eminence, we find these limitations of the right of appeal to independent arbitration, which are not only exceedingly irritating but wrong in principle. It ought to be possible to refer any dispute to arbitration, and the existence of such a possibility in practice reduces the risk of friction between contractors and purchasers.

THE ELECTRIC RAILWAY AND TRAMWAY CARRIAGE WORKS, PRESTON, LANCS.

We have recently described in the Electrical Review the equipment and organisation of the English Electric Manufacturing Company's plant at Preston, the opening of which, we feel bound to believe, marks a turning point full of promise for the future in the development of British manufacturing in general, and of the electrical manufacturing industry in particular. In our article describing these works we had occasion to refer to this company as collateral in its functions with another Preston undertaking situated immediately alongside—the Electric Railway and Tramway Carriage Works, of the success of which it has been in some respects a natural consequence.

E

We now propose to describe these tramcar building works which, though in operation for something less than 18 months, have already reached a most important position in the tramway industry. This position is due not merely to the fact that the works are crowded with orders at profitable prices, and that the enterprise is therefore a commercial success, but much more to the fact that in their inception, equipment and development there has been embodied a clear and logical understanding of the basis upon which our newer manufacturing must proceed to secure success against the keen and intelligent world-competition, to which, from this time on, it will be subjected.

Erecting Shop.

The building of the Preston Carriage Works was due to the foresight of certain gentlemen prominently connected with tramway undertakings, among whom may be mentioned Messrs. George Flett and John Kerr, managing directors of Messrs. Dick, Kerr & Co., Limited, Mr. Benjamin Sykes, Messrs. Richard and John Prestwich, Barningham and Boddington, Mr. George Frederick Fry, and Mr. George Richardson, chairman of the North Metropolitan Tramways, now the chairman of the Carriage Works Company. To these gentlemen, all of them occupying the position of directors or investors in traction undertakings in Great Britain or abroad, it was perfectly clear two and a half years ago that an immediate and enormous development of electric tramway undertakings was about to begin in the United Kingdom. Equally patent was the fact that the existing manufacturing facilities would be in no wise capable of supplying the necessary equipment. It was, therefore, their double duty, as patriotic Britons keeping in mind the manufacturing prestige of their country, and as far-sighted investors looking for a chance to make money, to seize the opportunity, lay down the proper manufacturing plant, and place themselves in a position to take care of the business rapidly coming up. To this end a suitable site of 15 acres, upon which a couple of buildings which might be made available already existed, was purchased at Preston, Lancs., and as manager and superintendent of the new undertaking Messrs. Stanley and Anger, who had occupied corresponding positions in one of the most important of American car-building concerns, were at once engaged. These gentlemen, duly installed, were given *carte blanche* in the matter of arrangement and equipment of the new works, the only stipulation made being that when completed they should be equal for the rapid and cheap production of tramway rolling stock of the highest class to any other establishment of the kind in the world. The results have justified the sound judgment of the directors and their confidence in the ability and experience of their management.

The dominant idea in the arrangement of the works throughout is economy in time and space in the handling of material. With this end in view all raw material entering the works passes successively through the different operations which make it fit to take its place as part of the finished product, and as far as possible, the point where such operations take place is immediately approximate to that in which the material is to be used. Economy of power, a scarcely less important consideration, is secured by the use of electric driving, with a reasonable extension of the principle of subdivision of power for the driving machine.

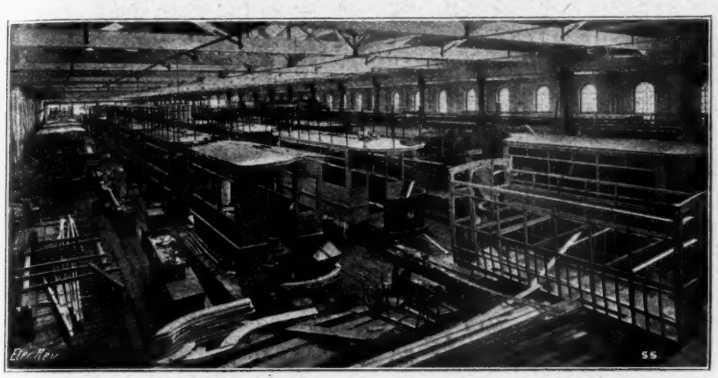
A reference to the ground plan of the works will show that all material entering over the railway track passes first the stores for small material, and then, in the case of timber, to the storage warehouse and to the four acres of storage ground reserved for this purpose. In the storage warehouse, for the class of timber which experience has shown can be properly dealt with in that manner, drying kilns are arranged on scientific principles, and the treatment of the wood considerably facilitated, to render it suitable for use under the stringent conditions of tramway service. It is, of course, understood to be indispensable that any such artificial seasoning should only be applied to such classes of timber as are susceptible to this treatment, without lessening any of those qualities which belong to the same timber when dried naturally in the open air.

Passing from the warehouse, the main material for the shops enters the wood-working department, where in a shop 413 feet in length is contained what is perhaps a unique assortment of automatic and highly-developed wood-working machinery. The first process is, of course, the rough cutting of the timber by band-saws, &c., into shapes generally suitable for the purpose in view, after which it is taken in hand by an assemblage of shaping machines of many types, and arrives at the other end as a finished part of the standard types of tramcar manufactured by the works.

Our illustration of the wood-working shop will show that it is entirely clear from the *débris* and confusion which it is usual to see in a manufacturing establishment of this class. The reason for this is very simple. All the cuttings, shavings, and refuse from the different tools are piped by the agency of a centrifugal exhaust into the boiler-room, where they at once become, not "matter in the wrong place," but an important factor in the economy of the undertaking. The floor of the wood-working department is of cement, a very proper provision for the avoidance of fire in the presence of machinery of this class. To the right and left of the wood-working establishment run the main erecting and painting shops to which the timber material, which has passed after being manufactured into the store

Wood-working Shop.

rooms, is issued finished and ready for erection into completed car bodies. In practice the operation of the wood-working shop is continuously to feed into the store rooms these finished completed parts, and equally continuous is their assemblage into tramcars to fill the many orders of the company. It may be added here as a suggestive comment on the value of obtaining such a uniformity of parts as an essential feature in the economy of output, that the works have for some time past refused to consider the construction of car bodies which would involve a departure from their standard patterns. It is, of course, essential, before such a policy can be capable of successful commercial adoption, that the details of design and construction should be worked out by experienced hands, and be beyond legitimate criticism,



Paint and Erecting Shop.

and also that the range of patterns should be wide enough to cover all practical requirements. This being done, and not before then, manufacturers can safely afford to ignore the amateur specifications of the "universal" engineer.

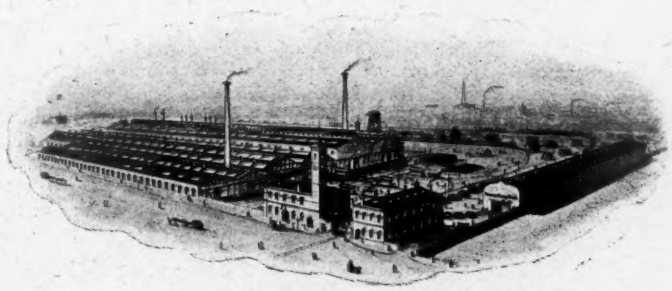
The smith and iron working shops, as will be seen in the ground plan, cover a considerable area. They are, like all the other shops, roomy and well lighted, and the men in them work under the best conditions. Naturally, however, as the iron work of a tramcar is only a minor portion of the material which enters into its make-up, these shops are not the most important or interesting department of the company's works. It is sufficient to say that all the machines are of the latest and best of their type, and of course electrically driven throughout.

The main erecting and painting shop is, properly, a building of great capacity, being 376 feet in length, and 110 feet in width. At the extreme end are the store rooms and the varnishing and finishing departments. From these, eight tracks run to the front of the shop, where a roomy and well-equipped sub-basement affords facilities for the erecting and testing motor pits. In front of the shops a traverser equipped with electric drive and hoist carries completed cars or material to and fro between the railway trucks and the different shops, this traverser being arranged with tracks of varying gauges to suit the different varieties of rolling stock which it has to handle. In the yards an electric locomotive fills a multiplicity of functions, bringing trucks backwards and forwards from the docks and the sidings of the Lancashire and Yorkshire Railway and handling material through the yards.

It is a matter for congratulation to the electrical engineer to see the important part which electric driving occupies in the economy of these works. A word may be added as to the equipment of the power station. Here two 320-H.P. tandem compound 250-volt sets, operated condensing, with a cooling tower and reservoir, are installed in conjunction with storage batteries of ample capacity and complete switch-board equipment. By means of the storage battery 500 volts is readily obtainable for the purpose of testing cars completely equipped with motors, &c., before shipment, on a track with varying curvatures laid out within the grounds. In the boiler room are three 250-H.P. Lancashire boilers, using mainly refuse fuel from the wood-working department. As may be expected, therefore, the works are operated with a maximum of economy in generation of power. For the distribution of power some 30 odd direct current multipolar 250-volt motors are in service. These are of the open type, enclosed in wooden boxings, and in the case of large tools are belted direct. For the smaller tools a number are grouped together to a single motor of suitable capacity.

Since the opening of the works on March 23rd, 1899, not a single interruption either to the works as a whole or any individual tool can be attributed to electric driving, and this in spite of the fact that some of the larger wood-working machines offer an intermittent load of the severest character. When this is kept in view side by side with the freedom from shafting and belting and the economy of generation and transmission, the case for electric driving, even under circumstances not particularly favourable, is established beyond a question.

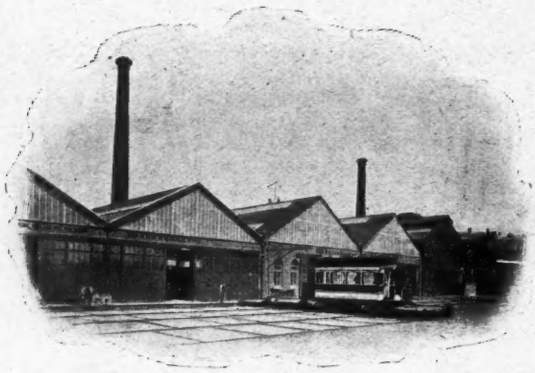
Something should be added as to the output of these works. It was recognised by the management that as a new undertaking commencing operations in a country and a field peculiarly conservative, in order to gain the large and immediate success necessary for a satisfactory financial outcome, something more must be done than to copy with, perhaps, improvements in detail, the practice already existing. Since the commencement of their actual working 15 months ago they have placed on the market tramcars of various types, each with distinctive characteristics which are sufficient to mark them as coming from the Preston Works. In top-seat cars they have produced what is generally known as the Liverpool type; the features for which they claim superiority are:—the improved interior design with its roominess and ample ventilation, the new roof construction adapted to meet the severe strains of electric traction, and the handsome though not over-elaborated interior finish, proper to a vehicle which is to be the carriage of the general public and which must yet not require the care and expenditure in upkeep of a gentleman's private brougham. To this type of top-seat car they have lately added, from the design of Mr. C. R. Bellamy, the general manager of the Liverpool Corporation Tramways, a reversed stairway, the desirable features of which are a normal increase in



Bird's-eye View of Works.

carrying capacity of 12 per cent., the protection of the driver from inclement weather and the passengers ascending and descending from the danger of being jerked off on to the pavement. The top-seat cars of the company have been manufactured for operation both with four-wheel and bogie trucks, and they have also turned out large numbers of single-deck tramcars of the American pattern of varying lengths and carrying capacities. Of interest, also, are the cross bench cars constructed by them for the Blackpool and Fleetwood Tramroad, of which an example was shown at the International Tramways and Light Railways Exhibition in London. Cars similar to these are in hand at the works for the Camps Bay and Sea Point tramways in South Africa, and for the Calcutta tramways

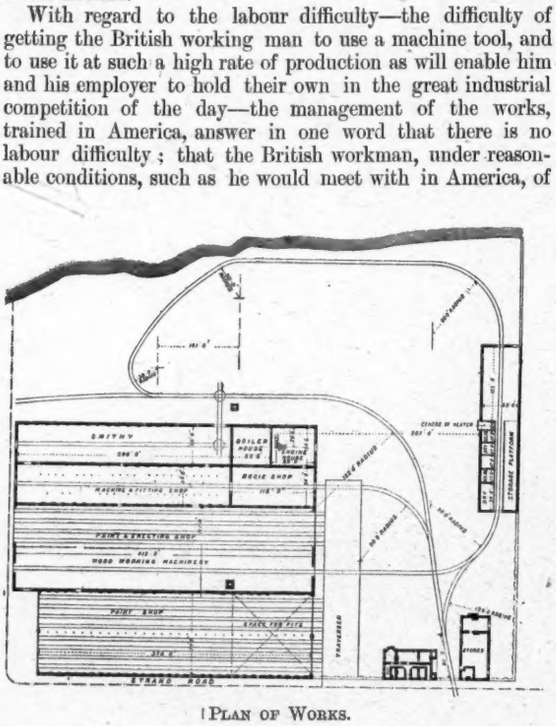
in India. The most difficult car building which the company has undertaken up to the present was involved in the supply of five motor cars recently to the Waterloo and City Railway in London. It is a gratifying indication of the development of the industry to which the Electric Railway and Tramway Carriage Works have in some measure contributed, that cars for this line could be furnished from works in this country which, from all points of view, compare most favourably with the original equipment provided from America. This is specially significant when we remember that only 2½ years ago the purchase of American rolling stock for the initial equipment of the Waterloo and



View of Traverser.

City railway was made the subject of a Parliamentary question, with the unsatisfactory reply that they could not possibly obtain a reasonable delivery of this class of car in Great Britain.

With regard to the labour difficulty—the difficulty of getting the British working man to use a machine tool, and to use it at such a high rate of production as will enable him and his employer to hold their own in the great industrial competition of the day—the management of the works, trained in America, answer in one word that there is no labour difficulty; that the British workman, under reasonable conditions, such as he would meet with in America, of



Plan of Works.

roomy and well-lighted shops, of fair hours of labour and of fair pay, does his work, and does it as speedily as, and if anything better than, the man on the other side of the Atlantic. We have no comment to make on this answer except that it sounds curiously like a refrain of something we have heard from South Africa, that "the men are splendid," but the leading—not quite so good.

Altogether, it is satisfactory to find from a visit to the car works at Preston that this particular British industry, with a reasonable inoculation of recent American experience, is easily able to hold its own, not only for the supply of tramcars for this country, but in the even more important field of colonial and foreign export trade. It is, indeed, a good thing to see at Preston the construction of tramcars for South Africa and India, and it is equally pleasing to note that beneath them will be placed electrical equipments of British manufacture to be driven by current generated by British dynamos and engines.

ELECTRIC CRANES.

(*Concluded from page* 168.)

The operator's cage for a three-motor crane should contain the following electrical equipment:—

(*a*) Three controlling and reversing switches.

(*b*) One main switch, which can be used in cases of emergency for cutting off the current entirely from the crane.

(*c*) One ammeter.

(*d*) Two single-pole main fuses.

(*e*) One wall socket for inserting plug for portable hand lamp.

If the crane is worked from below, by means of ropes or chains, it is desirable to have switches with the "fly back" motion, so that as soon as the chains are released, current is cut off from the motor.

No mention has been made of the car controller type of switch. This type has been used with satisfactory results in America and on the Continent, and is being introduced into this country by our American and German friends. Whilst the controller for this class of work is a good deal more suitable than the ordinary metallic switch—yet in our opinion it does not come up to the liquid starting and reversing switch, and it is a good deal more expensive.

Brakes.

Single-Motor Crane.—The single-motor crane is only fitted with an ordinary mechanical brake for holding or lowering the load, various types of which are in daily use on rope and shaft-driven cranes. No additional brake is fitted on the motor.

Three-Motor Cranes.—In the case of three-motor cranes, the practice of different makers varies a good deal.

An electro-magnetic brake is, however, always fitted on the hoisting motor, and usually works against a pulley fixed on the armature spindle. For mechanical reasons it is not desirable to arrange the brake pulley on the commutator end of the armature spindle, as is often done, as the strains are thus transmitted the length of the spindle. Wherever possible, the brake pulley should be fitted near the driving pulley or pinion.

The magnetic brake takes the form either of an ordinary band brake, actuated by means of a plunger working in a solenoid, or of two blocks of wood, turned out to fit the brake pulley, and working against the two sides of the pulley.

It is important with a band brake to have a dash pot to allow the brake to come on gradually, as otherwise the jerk transmitted to the gearing is liable to cause strains which will do damage. The windings of the brakes in either case can be either shunt or series.

In the case of the shunt winding, which necessitates in all eight wires across the span of the crane, the brake is *full on* when the current is totally cut off from the hoisting motor, whilst it is *full off* as soon as the leads to the hoisting motor are alive. It will thus be seen that this winding is suitable only as an emergency brake, in case anything happens to the hoisting motor, in the form of a fuse blowing when the load is at the top.

With a series winding, however, on the brake, necessitating only seven cross wires in all over the span of the crane, a very even and gradual braking effect can be obtained, and this form of brake can be used for gradually lowering any size of load. It will be obvious that on lowering a heavy load the power required to be developed by the motor is only a small one; consequently a few amperes only are passing through the series coils of the brake, and consequently a small force only is tending to draw the brake blocks off the pulley.

With a light load, however, the power required to be developed by the motor is an increased one, hence the current passing through the series coils of the brake is increased, and consequently the force tending to remove the brake blocks is also an increased one.

It has been found in practice that with a shunt winding on the brakes, a mechanical brake is desirable in addition,

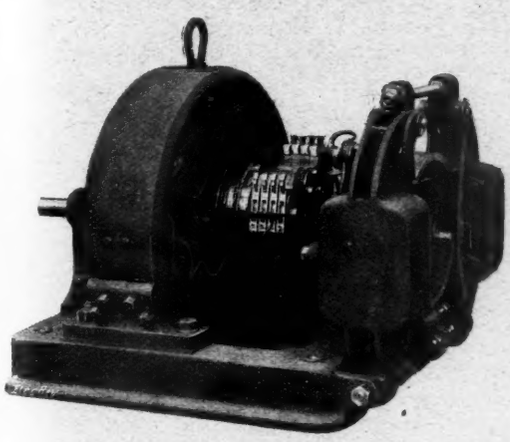


Fig. 28.—Open Type Crane Motor, with Magnetic Brake.

and that the load is controlled in lowering by this mechanical brake, the magnetic brake acting only, as pointed out above, as an emergency brake.

With a series winding on the brakes, however, no mechanical brake is actually necessary, as a perfect control can be obtained by means of the magnetic brake. If the load tends to race on lowering, the switch is pushed further over, which diminishes the current through the motor, and consequently also through the series coils of the brake, and this, as pointed out above, reduces the force tending to lift off the brake blocks.

Some crane makers prefer, however, to fit a mechanical brake in addition to the series magnetic brake; this is actuated usually by means of a square shaft running the span of the crane, and which can be worked from the operator's cabin by giving the square shaft a turn in either direction, which either puts on or releases the band brake.

Some heavy cranes recently designed by Messrs. Broadbent, of Huddersfield, were fitted, in addition to the series wound magnetic brake, with an automatic mechanical brake, so arranged that in lowering the resisting effort of the brake is in exact proportion to the load on the hook, and is, in fact, controlled by the load. In hoisting, the brake is arranged to be cut out altogether.

Although a brake of this description is not a necessity, it is undoubtedly a refinement, and does not add much to the cost of the crane.

There is no question that in the early days of electric cranes, it was a serious difficulty to find out what arrangement would be most suitable for lowering heavy loads at a reasonable speed without fear of racing.

The series-wound motor, most suitable for hoisting work on account of its large starting torque, has the objection of being a bad speed regulator, consequently with a heavy load to be lowered, not only is the weight of the load often sufficient to pull itself down, but when the series motor is used *as a motor*, it tends to race on what is a very light load for it, with the result that lowering is carried out at a dangerous speed. Devices have been tried for allowing the load to lower itself, by cutting the motor out altogether, or by turning the motor into a dynamo, and allowing the load to pull itself down against this brake, thus checking the speed.

Although these arrangements have worked well in some cases, it is doubtful whether the additional complications are advisable, and in all probability the most suitable plan is to use a series-wound magnetic brake on the motor, and in some cases where heavy loads are handled, a mechanical brake in addition, as suggested above. A very perfect regulation of the speed can be obtained by this means, the mechanical brake being also a stand-by in case anything happens to the magnetic brake.

Working of the Crane.

There is not much further to be said on the subject of working the different types of crane.

In the case of the single-motor crane, the motor is switched on, and continues running at a constant speed, and in the same direction, whilst the crane is in use.

The individual motions of travelling, traversing, and hoisting are controlled by separate levers, which actuate the belts or friction clutches, which derive their power from the main shaft.

Any variations in speed required have to be obtained by changing the ratio of the gearing by means of friction clutches. A resistance in series with the shunt of the motor will also give a variation in speed, but this is not often made use of in practice.

In the case of the three-motor crane, the levers control the motors themselves, consequently when the direction of working is reversed, the motors themselves are reversed.

The motors being geared direct to their work, it is impossible to have a motor running round idle, and consequently no power is consumed unless work is actually being done.

Crane Speeds.

The following table gives the speed in feet per minute, up to which the different motions of the crane should be worked.

The smaller speed in each case represents the speed at which the full load should work, whilst the quicker speed represents the one for the lighter loads.

With series-wound motors on three-motor cranes, almost any speed can be obtained between these two limits.

The speeds given are a good deal higher than are usually found at work; but if a three-motor crane is adopted at all, full advantage should be taken of it, and the quicker speeds should be used, excepting in very special cases where it would be dangerous or inconvenient to work at so fast a speed.

Load..	..	5	10	15	25	50	tons.
Hoist	..	15 to 25	8 to 20	5 to 16	4 to 16	3 to 14	ft. p.m.
Traverse	..	90 to 150	50 to 150	45 to 150	45 to 150	40 to 120	ft. p.m.
Travel	..	100 to 300	100 to 250	100 to 250	100 to 250	70 to 170	ft. p.m.

As regards the power of motor most suitable for the different sizes of crane—it is almost impossible to draw up a

Fig. 29.—Enclosed Type Crane Motor.

table which would be of any use when applied to the various designs of crane, as the efficiency of the gearing varies a good deal with different designs.

Some rule should, however, be followed in arriving at the proper size of motor to use on a crane. The horse-power may be arrived at by working out the actual power used in lifting the load, then allowing 25 per cent. for the power lost in the gearing and taking this for the nominal horse-power of the motor. This figure

of 25 per cent. will be sufficient for machine cut spur gearing, but for cast wheels not machined, or for worm gearing, a somewhat higher figure must be taken.

Further, the motor for crane working should be rated at a figure such that it is capable of working 40 per cent. below this for three hours with a temperature rise not exceeding 70° F. for the open type and 90° F. for the totally enclosed type—above that of the surrounding atmosphere—and is capable of withstanding momentary overloads of 100 per cent. above the rated output without injurious sparking.

As an example, if a motor is rated as a 10-H.P. crane-motor, it should be capable of running at 6 H.P. for three hours without rising in temperature above the figure specified, and further, of running up to 20 H.P. momentarily without injurious sparking.

At present, the rating of crane motors by different manufacturers is extremely misleading—some allowing more margin in their motors than others. As an example, one firm will call a motor 10 H.P. for crane working, whilst another firm will call an identically similar machine 15 H.P. for crane working.

As regards the speed of crane motors, the speed of the hoist motor should preferably be kept down to 300 revolutions per minute for the larger motors, and 500 revolutions per minute for the smaller ones, whilst the speed of the travel and traverse motors should not exceed 700 revolutions per minute.

One can take, therefore, the three speeds of 300, 500, and 700 revolutions per minute as the most suitable speeds for crane motors to work at.

The slower speeds certainly mean higher initial cost in the electrical equipment, but against this has to be set the lower initial cost of the gearing, a certain saving in wear and tear of the gearing, and finally, the advantage of the quicker reversing power of the slow-speed motors.

In the case of the single-motor cranes, the question of speed is not of so great importance, and any motor may be taken, running at its normal speed.

Finally, as to the type of motor most suitable for crane working, in order to save space and weight the multipolar type has advantages, and the illustrations herewith, fig. 28 and fig. 29, show two designs suitable for the work. The motors should be either of the open type, as shown in fig. 28, easily accessible for cleaning, &c., or of the totally-enclosed type, similar to fig. 29, but with the casting solid, and the revolving brass commutator cover also made solid.

The ventilated enclosed type, although often used, is usually not sufficiently enclosed to keep dirt out, while it is too much enclosed to encourage the average British workman to spend any time in cleaning more than the outside of the case. The totally-enclosed type, however, which should be capable of standing a fire hose turned on it without damage, is not likely to allow much dirt to accumulate within it.

BRADFORD CORPORATION TRAMWAY CONTRACTS.

In order to carry out certain extensions of the Bradford electric tramway system, the Corporation some months ago invited tenders and awarded contracts, which are now in course of performance. Some exception has, however, been taken to the manner of their execution; the grounds for complaint are set forth in the following letter, which was addressed on July 30th, by one of the firms tendering, to the Mayor and Council of Bradford :—

Dear Sirs,

In January, 1900, a specification was issued by you for your electric tramway overhead line.

The specification was in accordance with approved and recent practice.

We tendered in strict accordance with your specification, our tender being £13,540, as against £12,064 tendered by McCartney, McElroy & Co, Limited, which latter tender was accepted by you.

We were informed that no deviation had or would be made in the specification, and that the tender which received your approval was absolutely in accordance with the specification.

We are surprised to learn that extensive deviations from the specification have been allowed, without any corresponding reduction in price. The following are examples :—

The specification stated—"All insulators shall be of gun-metal, with drop forged steel insulated bolts, not less than ⅞-inch in diameter. Double insulation shall be employed throughout, and shall be equal in every respect to the sample to be seen at the city surveyor's office.

"That the insulators and other fittings intended to be used in this contract must be equal in every respect to the sample to be seen at the city surveyor's office, Town Hall, Bradford."

The samples shown by you, in accordance with the above, were insulators such as are used by the Liverpool Corporation, and were of the heavy "Ætna" type, with ⅞-inch solid drop forged steel bolts.

After accepting the tender of McCartney, McElroy & Co. you passed a resolution (Tramways Committee, June 11th, 1900, Council, July 10th, 1900,) permitting the use of "Hecla" insulation instead of "Ætna." This "Hecla" material costs 25 per cent. less than "Ætna," and is made, as a cheaper grade, by the same manufacturers.

As a matter of fact, the insulators which are now being supplied to your line are of a make called "Dirigo," have only a ⅝-inch bolt, and have not been tested. The weight of these insulators is about 70 per cent. that of the sample specified by you.

We would call to your attention the fact that the late Dr. John Hopkinson, F.R.S., consulting engineer to the Liverpool Corporation, &c., after most elaborate tests, decided that for heavy "three-nought" wire, as specified by you, ⅝-inch bolts were far too light. He therefore introduced the special extra strong (and more costly) insulator with ⅞-inch bolt.

It is this insulator, specially manufactured to his design, which has been used throughout Liverpool, and which was specified by you.

The insulators now being put in on your lines are lighter, weaker, and cheaper than the sample specified by you, and of an entirely different type.

Furthermore, your specification called for "Ears to be of bronze metal, and to be not less than 2 feet in length with deep grooves to fit the trolley wire, tinned ready for soldering."

You exhibited, for the guidance of offerers, a sample ear in accordance with the above, and stated that the material to be employed must come up to the sample shown.

The ears which are now being supplied to your line are only 18 inches long, are lighter, and are not by any means as deeply grooved as the sample shown. The tests made by Dr. John Hopkinson led him to decide that where heavy trolley wire, such as you are using, is employed, no ears less than 2 feet in length could be used with safety, and that a specially deep groove was required to firmly hold the trolley wire.

You authorised this change by resolution of Tramways Committee, June 11th, 1900, accepted by Council July 10th, 1900.

Your specification described the section insulators to be used, saying that the same were "to be made in accordance with the drawing to be seen in the city surveyor's office."

Your drawing represented a special type of section insulator designed by your engineers for use on your lines. The sample shown at your surveyor's office was not of this type, but great care was taken to explain to all tenderers that those to be supplied must be fitted with a special bridging switch device. The section insulator which is now being supplied to your line is totally different to the sample and to the drawing shown.

Your specification also stated "that the poles shall be provided with cast-iron ornamental finials, joints, collars, and bases, all of which must be in accordance with the drawings to be seen at the city surveyor's office."

The bases now being supplied to your line are much thinner than those shown on the drawing, and are not provided with lugs at the bottom to keep the base central. This greatly reduces the weight of metal in the bases, which, as now being supplied to you, are not in accordance with your specification. You authorised this reduction in weight of bases in Tramways Committee and Council, June 11th, 1900, and July 10th, 1900, respectively.

Moreover, there have been various deviations in construction of bracket arms, which decrease their efficiency and diminish their cost to the contractor.

The flexible suspension brackets were specified to be entirely free from the bracket arm fittings. In those which are now being supplied the clips of the tie rods supply the bases of one flexible suspension bracket.

We are greatly surprised at these deviations from the specification, as in every case cheaper and less permanent and efficient material is being supplied than that specified by you.

We estimate that the difference in cost between the materials specified as those which had to be furnished and those which are actually being supplied amounts to £851 16s. 10d., which amount (considerably over one-half of the difference between our offer and that of the successful offerers) represents a bonus paid by you to your present contractors for furnishing you with inferior material to that which you originally required from all persons tendering to you.

At the present writing we do not know whether there are or are not any further departures from the specifications to which we tendered.

We would respectfully submit that your action in this matter imposes a great hardship upon contractors like ourselves, who, having in good faith tendered to your specification and samples, find that you favour our competitors by practically releasing them from their contract obligations.

We were honoured with your previous contracts, which we

filled to the best of our ability. You have certainly taken no exception to the work done by us. We were beaten, we understand, solely on the question of price. We now find that our competitors have been given such advantage as in all probability enables them to fill your contract with a very considerable reduction in costs. Had we contemplated any such possibility we should have greatly reduced our original offer to you, and in all probability continued as your contractors.

We consider it our duty to file with you our protest against such unfair discrimination.

We are, dear Sirs, yours faithfully,
Robt. W. Blackwell & Co., Ltd.

The following is an extract from the minutes of the Bradford Tramways Committee, of June 11th :—

Overhead Equipment of New Tramways.—The offer of Messrs. McCartney, McElroy & Co., Limited, to substitute "Hecla" in place of "Etna" insulating material as specified was accepted.

Resolution authorising the city surveyor to determine whether 24-inch or 18-inch "ears" are to be used for attaching the trolley wires to the overhead supports, and also as to the thickness of metal which shall be required for the bases of the poles.

These minutes were accepted by the City Council at a meeting on Tuesday, July 10th.

It will be noticed that permission here is given to Messrs. McCartney, McElroy & Co., to substitute Hecla for Etna material. These Hecla bolts were $\frac{3}{4}$ inch in diameter. For some reason or other it is rumoured Messrs. McCartney, McElroy & Co. dropped the Hecla material suddenly and entirely, and said that they could only supply $\frac{5}{8}$ inch Dirigo bolts. These alterations were made in the specification apparently without any reduction in price whatsoever.

The unfairness of these proceedings is obvious. Further comments will be found in our leading columns.

CORRESPONDENCE.

An Electromobile Run.

It will interest your readers to know that a carriage propelled by electricity, a "voiturette," to carry two persons, constructed under the patents owned by this syndicate, made a most successful trial trip from London to Brighton on Saturday last, using one charge of electricity only, the total run on that day being 53 miles by cyclometer, or one mile over the exact distance between the two towns.

We started from Wilson Street, Finsbury Square, at 11.30 a.m., passed through the congested traffic over London Bridge, by the Borough, Kennington, Brixton, Streatham, Croydon, Merstham, Redhill, Horley, Crawley, Handcross, Hickstead, and Patcham to Brighton. The following are briefly the particulars of power, &c. :—

This voiturette is equipped with two 2-H.P. Joel electric motors, running at a speed of 600 revolutions per minute with 30 volts; these two motors are fixed on a detachable spring frame, and drive the two back wheels of the carriage separately by 1 inch chain gear of 9 to 1. The current is supplied by 32 Rosenthal storage batteries, made up in two sets of 16 cells, joined in parallel, giving 32 volts, and 20 to 40 amperes, with an output of 140 ampere-hours.

The total weight of the carriage is under 12 cwt., of this, $7\frac{1}{2}$ cwt. is battery, motors 2 cwt., and the carriage itself only $2\frac{1}{2}$ cwt. The wheels have pneumatic tyres, the back wheels are 2 feet 9 inches diameter, and the front wheels 2 feet 6 inches diameter. The front track is 3 feet, and back track 4 feet 6 inches, and the base is 4 feet 6 inches. The controller is very simple in construction and action. The system of electrical changes is such that when the voiturette is ascending hills, the motors work at their highest efficiency and at normal speed, they are geared down to run the car up hill at 6 miles an hour, whilst on the level the car is run from 8 to 12 miles, or faster if desired. There are also two slow speeds forward of 3 and $4\frac{1}{2}$ miles, and a slow speed backward of 3 miles per hour. When going down hill the motors act as a brake, and on steep hills give a back charge to the batteries.

A careful series of tests were made on the journey, and the current used was measured. On level roads such as from the Elephant to Croydon, the current varied from 10 to 20 amperes per cell; on inclines of 1 in 40, such as experienced between Croydon and Merstham, the current rose to 40 amperes per cell, the average current used being about 20 amperes per cell. On the steepest part of Redhill the current touched 45 amperes per cell, this, with a pressure of 32 volts, giving an effective 4 H.P. to the carriage. On the other hand, when going down Merstham Hill, Earlswood Common, Handcross Hill, &c., we were recharging about 15 amperes per cell, or practically returning about one fourth of the current, the returned current making an appreciable difference in the run. (Of course, on level roads, the distance travelled would have been very much greater.)

The run was made at an average speed of 10 miles per hour, or in $5\frac{1}{4}$ hours actual travelling, and varied from 15 miles per hour on the level or slight inclines to 6 miles per hour going up the hills.

The carriage was made by Mullinger, of Northampton, and the electrical and mechanical part by Messrs. Joel and Potter, of London. The roads were in good condition, but a very strong head wind prevailed throughout.

The National Motor-Carriage Syndicate, Ltd.
V. C. Doubleday, *Secretary.*

London, *July 30th*, 1900.

Current Specifications.

One cannot help agreeing with the intention of your remarks on arbitrary clauses in specifications drawn up by engineers. Yet, even here, it is well to look at the other side—and, indeed, the fact of the clauses in question appearing so regularly shows that the need of them has been felt. The following random list of sad experiences can be added to by anyone who has made a few pilgrimages through electricity works :—

1. Alternator, owing to armature reaction, would not take its full load; was replaced by another which was worse.
2. Dynamo heated so that full load meant an almost certain "bust."
3. Engine was full of specially patented specialities, which went wrong at awkward times. At the maker's test it went beautifully, but after a month's station work it became a perfect glutton for steam and oil.
4. Buyer trusted to maker's honour, and got an engine of which the maker had for years been trying to rid himself.
5. Generating set not up to the mark. The makers kept a staff working in the station at intervals, until the set was reconstructed and went fairly well after a year or so.

All of the above machines were from well-known firms.

The engineer—especially of a small station—severely feels the pinch of having part of his generating sets ineffective, and when the comments of the technical press on his costs are thrown at him by those in authority, he inwardly vows that the next machines shall be right if specifying can do anything. As you have remarked, our big consulting engineers do not need these arbitrary clauses, but they hold positions such that a hint from them is often worth more than a lawyer's letter from a small man.

When our manufacturers cease to use their clients' works as testing departments, we will hear less of arbitrary specifications.

C. Turnbull.

Tynemouth, *August 3rd*, 1900.

Electric Cranes.

I have been much interested in your series of articles on "Electric Cranes," especially in the last, on the subject of switch gear. I should like, with your permission, to put the following questions, in the hope that you or some of your readers will give their experience :—

(*a*) What is the best acid or salt solution to use in the liquid rheostat?

(*b*) When a cast-iron tank is used, what is the best means of insulating it from the iron framework and from the operator?

(*c*) Is a wheel or slider running on a hard-drawn copper wire sufficient contact for, say, a 20-ton traveller working at 110 volts?

My experience is that iron channels or slippers are used as insulated rails. This, of course, adds considerably to the expense of fitting up.

Dealing with your advocacy of three separate tanks for a three-motor crane, it appears to me that a triple rheostat in a cast-iron tank is both neater and cheaper. The splashing can easily be stopped by keeping the sides high and putting a cast-iron baffle plate between each moving plate in the manner usual in locomotive tender construction.

I am looking forward to your next on brake gear, on which I may venture to make a few remarks.

C. B. Nixon.

Manchester, *August 7th*, 1900.

Dynamo Design.

Let E represent the E.M.F. in volts.

$$F = \frac{80{,}000 \times 16{\cdot}5}{1{\cdot}25} = 1{,}056{,}000 \text{ C.G.S. lines, useful flux.}$$

$r = 512$ total number of active conductors.

$\frac{n}{60} = 21{\cdot}67$ speed in revs. per second.

$$\text{Then } E = \frac{F\, r\, \frac{n}{60}}{10^8} = \frac{1{,}056{,}000 \times 512 \times 21{\cdot}67}{10^{-8}} =$$

$$\frac{11{,}716{,}362{,}240}{100{,}000{,}000} = 117 \text{ volts.}$$

Deducting about 2 per cent. volts lost due to armature resistance gives 115 volts nearly, delivered at the terminals of the machine.

Undy.

The P.D. between the terminals of the dynamo under the given conditions would be 117·1 volts.

This result is obtained by use of the formula

$$E = \frac{N\, Z\, n}{10^8}$$

where E = P.D. generated (volts).
N = Total number of magnetic lines of force cut by conductors.
Z = Total number of conductors (in series).
n = Number of revolutions per second of armature.

With the data as in the present case we have :—

$$E = \frac{16{\cdot}5 \times 80{,}000 \times 2}{1{\cdot}25} \times \frac{512}{2} \times \frac{1{,}300}{60} \times \frac{1}{108} = 117{\cdot}1 \text{ volts.}$$

Periodic Reader.

Motor Starters.

In your issue of August 3rd, Mr. D. C. Bate falls foul of my statement that all the starters available are rated too high, and he suggests that users of rheostats preserve a large amount of secrecy as to what they require.

He states that he does not consider 10s. per H.P. on a 5-H.P. motor an excessive price to pay, but my contention is that, in nine cases out of ten, 10s. per horse-power will not purchase a starter that will not burn out in use, whether it is ironclad or otherwise, and this is my reason for my views.

This correspondence started in consequence of some remarks *re* Bradford, where, I believe, a number of motors are taking the place of gas engines ; and in a majority of cases these gas engines would probably be driving on to line shafting, with most likely a loose pulley on the shaft and a corresponding wide pulley on the engine. Now I contend that if it is contemplated to instal, say, a 5-H.P. motor under these circumstances, that it will be cheaper to use a lightly rated starter, or, as Mr. Bate would have it, a 5-H.P. starter and use a fast and loose pulley.

To start this shaft, &c., direct with a starter would necessitate a rheostat capable of taking at least 50 per cent. more current, and this, according to Mr. Bate, would require a starter rated at some 15 H.P., which would mean something near 30s. per H.P. at the motor rating.

It may be want of electrical knowledge or want of knowledge of the slim methods of catalogue ratings, but I certainly think that a motor starter should be rated to stand as much overload as the corresponding rating of the motor. We have to sell our electrical goods to engineers and others, and to prove to them that we have something that is better than that which they have in use, and it certainly does not inspire confidence in our methods if one part of a machine has a 125 per cent. difference in rating to another part.

C. B. Callow.

August 7th, 1900.

PARLIAMENTARY COMMITTEES.

Batley Corporation Tramways.

The Select Committee of the House of Commons, under the chairmanship of Mr. Seale Hayne, sat on Tuesday last week to consider the clause relating to the wording of the tramways in the Halifax Road. After some discussion the Committee decided that the wording of the clause should be as follows:—"Provided always that, notwithstanding anything shown upon the deposited plans, Tramway No. 2*b*, such position in the Halifax Road shall be taken up so as to leave the same road for another tramway or light railway, if and when any such further tramway or light railway shall be authorised. Provided also that the user of the line of tramway or light railway shall be determined by the Board of Trade."

North Metropolitan Electric Power Bill.

This Bill, which seeks to provide electricity in bulk over a large area in Middlesex, Essex, and Hertfordshire, should have come before the House of Lords Committee, presided over by the Duke of Argyll, last week. All opposition, however, having been withdrawn, the Bill proceeded as an unopposed measure.

LEGAL.

Burke *v.* British Blahnik Arc Light Syndicate.

In the Chancery Division of the High Court of Justice on Tuesday, the case of Burke *v.* the British Blahnik Arc Light Syndicate came before Mr. Justice Kekewich on a motion for judgment.

Mr. Chubb said that when the matter was last before the Court, his Lordship heard a motion for the appointment of a receiver. He said that the plaintiff might take the usual judgment if he could obtain the consent of the trustee for the debenture holders, one of the defendants. This had not been possible as the gentleman in question was away from home. It would, therefore, be necessary to proceed merely on the writ.

His Lordship: Very well, then I will make the declaration.

London Electrical Cab Company, Limited.

The petition of C. E. Foster and others for the compulsory winding up of the London Electrical Cab Company, Limited, was down for hearing before Mr. Justice Wright on Wednesday.

Mr. Herbert Reed, for the petitioners, asked that the petition should stand over until after the long vacation, and Mr. Bramwell, Q.C., on behalf of other parties concerned, concurred.

His Lordship consented to the adjournment.

Electric Cranes.—In order to facilitate landing and embarking mails and baggage on the cross-channel mail packets, electric cranes are about to be placed on the landing stages at Dover. A great saving of time will thus be effected.

The *Manchester Courier* says that in connection with the general equipment of the new armour-plate making works which have just been completed by Sir W. G. Armstrong, Whitworth & Co., Limited, at Openshaw, the largest overhead electric travelling crane yet made in this country has been erected in the armour-plate casting department. This crane has been constructed by Messrs. Vaughan & Son, Limited, engineers, West Gorton, and during the past week has been submitted to exceptionally heavy tests, one of which, the hoisting of a load of 135 tons, was most satisfactorily dealt with. The crane is operated by four powerful electro-motors.

BUSINESS NOTES.

Electrical Wares Exported.

Week ending Aug. 1st, 1899.		Week ending July 31st, 1900.	
Alexandria	Value £83	Adelaide	Value £104
Amsterdam	25	Alexandria	32
Antwerp	70	Amsterdam	110
Auckland	25	Bombay	45
Bangkok	628	Bremen	230
Batavia	12	Brussels	27
Boca	240	Buenos Ayres	67
Bombay	57	,, Teleg. cable	700
Boulogne	17	,, Teleg. mat.	180
Buenos Ayres	131	,, Teleg. wire	100
,, Teleg. cable	657	Calcutta	2,046
,, Teleph. fittings	100	Cape Town	253
Calcutta	466	Chinde. Teleg wire	124
,, Teleg. wire	20	Colombo	50
Cape Town	134	Copenhagen. Teleg. wire	100
Christiania. Teleg. wire	71	Demerara. Teleg. mat.	87
Copenhagen. Teleg. wire	116	Durban	332
Durban	22	East London	492
Genoa. Teleg. mat.	95	Genoa	21
Gottenburg. Teleg. mat.	21	Hamburg	51
Hamburg. Teleg. mat.	21	,, Teleg. mat.	500
Hong Kong	134	Hiogo	99
Jersey and Guernsey	1,526	Hong Kong	24
Key West. Teleg. cable	46,000	Launceston	46
Lisbon. Teleg. mat.	40	Madras	17
Melbourne	146	Malacca	229
,, Teleg. mat.	1,143	Malta	308
Port Elizabeth	633	New York. 2,459 c. Teleg. appa.	
,, Teleg. mat.	162	Ostend	350
Sarawak. Teleph. mat.	68	Parana	291
Shanghai	198	Perth	60
Singapore	21	Port Elizabeth	1,100
,, Teleg. mat.	668	Rio Janeiro	180
St. Petersburg	837	Rosario. Teleg. mat.	522
,, Teleg. wire	380	Santos	252
Stockholm. Teleg. wire	28	Shanghai	180
Sydney. Teleg. cable	650	Singapore. Teleg. cable machinery.	2 006
Teneriffe	80	Sydney	548
Vigo. Teleg. appa.	35	Yokohama	209
Total	£55,764	Total	£13 117

Foreign Goods Transhipped.

Sydney. Teleph. appa.	Value £45	Cape Town. Elec. wire	Value £1,300
Tientsin. Teleg. mat.	188	New York. Elec. mat.	380
Total	£233	Total	£1,680

Electrical Wares Exported.

Week ending Aug. 8th, 1899.		Week ending Aug. 7th, 1900.	
Adelaide	Value £349	Adelaide	Value £278
Aden. Teleg. mat.	45	Alexandria. Teleg. mat.	188
Amsterdam	100	Amsterdam	30
,, Teleg. mat.	245	Auckland	1,596
Bangkok	86	Azores. Teleg. apparatus	2,382
Boca	284	Bangkok	42
Bombay	107	Bombay	70
Boulogne	90	Brisbane	950
,, Teleg. apparatus	2,900	Buenos Ayres	255
Brisbane. £0 tons iron teleg. poles, value not declared.		,, Teleg. mat.	225
Buenos Ayres	524	Calcutta	336
,, Teleg. wire	161	Cape Town	543
Calcutta	929	,, Teleg. apparatus	200
,, Electric launch	88	Colombo	87
Cape Town	214	Durban	373
,, Teleg. stores	16	East London	137
Colombo	39	Fremantle	125
Copenhagen	14	Georgetown	150
Delagoa Bay	28	Hiogo	15
Durban	10	Hobart	150
,, Teleg. mat.	31	Lyttleton	50
,, Teleph. mat.	44	Melbourne	870
East London	606	Nagasaki	92
Flushing	35	Nelson	297
Genoa. Teleg. mat.	35	New York. Teleg. cable	500,375
Gibraltar	61	Parana	2,0 4
Halifax (N.S.). Teleg. cable	555	Perth	161
Hamburg. Teleg. mat.	170	Port Elizabeth	150
Hong Kong	285	Rotterdam. Teleg. mat.	150
Jersey and Guernsey	50	Shanghai	64
Launceston	140	,, Teleg. wire (old)	150
Malta	30	Singapore	85
Melbourne	103	,, Teleg. mat.	129
,, Teleg. mat.	130	Sydney (N.S.W.)	743
Ostend	65	Sydney (Cape Breton). Submarine cable	468
Paris	848	Wellington	2,062
Penang	582	,, Teleg. mat.	1,831
Perth	29	Yokohama	448
,, Elec. tram machinery	598		
Port Elizabeth	26		
,, Teleg. mat.	223		
Port Said	101		
Rio Janeiro	166		
Rosario. Teleg. wire	17		
Rouen	160		
Santos	132		
Singapore. Teleg. cable	42,000		
St. Petersburg. Teleg. wire	84		
Sydney	2,113		
,, Teleg. mat.	844		
Total	£55,986	Total	£518,195

Actions.—At the Walsall County Court on Wednesday last week, Joseph Willis, Victoria Street, Ashton-under-Lyne, sued the Walsall Electrical Company, Bridge Street, Walsall, for £7 1s. 5d., work and material, and £50 a dishonoured cheque, part price of a dynamo and engine, and the company counterclaimed for £50 money paid by them on the dynamo and engine. The company's allegation was that the dynamo and engine were defective, and that plaintiff would not put them in good working order; but against this it was stated that the dynamo had been re-wound, and put to heavier work than it was calculated to do. A verdict was given for the plaintiff for the sums claimed, and the counterclaim was dismissed.

At Clerkenwell, the National Telephone Company, of Oxford Court, Cannon Street, E.C., was summoned by the Islington Vestry for having in May last fixed an overhead wire within the parish of Islington between 45, Park Street and 229, Upper Street, without first obtaining permission from the London County Council. A further summons against the company was for fixing an overhead wire which was not supported at intervals not exceeding 115 yards between Messrs. Dove Brothers' yard in Studd Street and 130, Upper Street, the exact distance being 126 yards, without having obtained permission from the London County Council or the local authority. Mr. Bramall prosecuted for the Vestry, and Mr. Goddard appeared for the company. On the first summons a plea of guilty was entered, and on the second the facts were admitted, but counsel denied that the definition of "street" in the Act included such a passage as that called Dove's Yard, which led to a meeting house of Plymouth Brethren, and was of a private character. On the first summons Mr. Bros imposed a fine of £5, with 2s. cost, and on the second a fine of 5s. and 2s. costs in order that the point of law involved might be raised in another Court.

Auction Sale.—From our advertisement pages to-day particulars may be obtained of an auction sale which is to be conducted by Messrs. Wheatley Kirk, Price & Co., at Ormonde Works, Romford, on August 28th and 29th. The plant to be offered includes various machinery, plating dynamos, machine tools, &c.

Bankruptcy Proceedings.—A receiving order has been made against Henry Howe, electrician, Derby, on his own petition.

The first meeting of creditors and public examinations are arranged for August 14th and September 11th respectively at Derby.

Notice is given of release of trustee (Mr. G. W. Chapman) in the case of F. W. Henton, electrical engineer, King William Street, Strand. Similar notice is given of release of the same trustee in the case of L. J. Lawrence, electrical engineer, Stafford Street, Old Bond Street.

Books Received.—"Journal of the Institution of Electrical Engineers." London: E. & F. N. Spon, Limited. 5s. Also Index and List of Members.

"La Telegrafia Senza Fili e La Canalizzazione Dell'-Elettricità Senza Fili." Rome: Tipografic Nazionale di G. Bertero. 1900.

"The Application of Electric Motors to Machine Driving," by A. Stewart, A.I.E.E. London: S. Rentell & Co., Limited. 1900. 1s.

"The Mechanical Equipment of the New South Station, Boston, Mass." London: British Westinghouse Electric and Manufacturing Company.

"The Law and Practice relating to Letters Patent for Inventions," by R. W. Wallace and J. B. Williamson. London: William Clowes & Sons, Limited. 1900.

"Transactions of the American Institute of Electrical Engineers." Vol. xvi. New York City: The American Institute of Electrical Engineers. 1900.

"Calendar of the Glasgow and West of Scotland Technical College for the Session 1900-1901." Glasgow: Robert Anderson.

"Electrical Enterprise in Argentina," by Ernesto Danvers. Buenos Ayres: J. H. Kidd & Co. 1900.

"Le Règne de Louis IV. d'Outre-Mer," by Ph. Lauer. Paris: Emile Bouillon. 1900. 12 francs.

"Duncan's Manual of Tramways, Omnibuses, and Electric Railways, 1900." London: T. J. Whiting & Sons, Limited. 3s. 6d.

Catalogues.—A preliminary list has been issued by the Electric Power Transmission Company, Birmingham, containing particulars and prices of their direct current enclosed motors, from ¼ to 25 B.H.P., and automatic starting switches.

A leaflet comes to hand from the General Electric Company, Limited, of various recent additions, such as high voltage water-tight switches, graphite rheostats, dry cells, &c.

The Bedford Engineering Company forward a price-list of their steam cranes, with various accessories.

We have received Pamphlet No. 70 from the British Thomson-Houston Company, Limited, dealing with their magnetic blow-out lightning arresters for direct current circuits of all kinds.

The British Westinghouse Company send us circular No. 1,029, in which their polyphase induction motors are very fully described and illustrated, with full tables of external dimensions and weights. These motors, which appear to be designed with great care and attention to detail, range in size from 75 to 850 H.P., and are built for frequencies between 120 and 50 alternations per second.

A pamphlet describing adjustable hanging telephones comes to hand from M. I. Vought, La Crosse, Wis.; another describes and illustrates adjustable pendants, in which the counter-weight consists of a ball hanging clear of the lamp suspender.

Messrs. E. F. Moy, Limited, send us leaflets showing their liquid resistance for theatre lighting, enclosed fireproof resistances, and distributing boards.

An illustrated pamphlet comes to hand from the Campbell Gas Engine Company, Limited, Halifax; describing their oil engines and embodying a report by Prof. Stanfield on a series of tests carried out by him on a 15-B.H.P. engine. The results showed the consumption of oil per B.H.P. hour to be: at full load, 0·846 lb.; at half load, 0·957 lb.; while at the maximum load of 17·8 B.H.P., the consumption was 0·773 lb. oil per B.H.P. hour with a mechanical efficiency of 89 per cent.

Messrs. Blackstone & Co., Ltd., of Stamford, send us a pamphlet dealing with their oil engines, and giving the results of tests made by the Highland and Agricultural Society of Scotland, last year, on ten competing engines. In these tests the Blackstone engines made a very good showing, consuming only ·746 lb. oil per B.H.P. hour

at the full load of 12·6 B.H.P., and 1·024 lbs. at half load. A large number of useful data relating to the tests are given, as well as ample particulars about the engine itself.

Cricket.—The annual cricket encounter between the Blackpool Corporation Electricians and the Southport Corporation Electricians took place at the Athletic Grounds, Blackpool, last week-end. The Blackpudlians won by an overwhelming majority.

The Copper Market in July.—Messrs. H. R. Merton and Co.'s statistical circular on copper shows that during the past month copper has advanced 25s. per ton in price, and that stocks have fallen 350 tons. The total shipments to Europe in July have been 21,226 tons, America contributing 12,054 tons of this amount. This latter total is, however, 5,800 tons below the shipments from America in June, and is also below the average for the previous 12 months. The shipments from Chili and from miscellaneous countries in July are also below the average, and only Spain and Portugal have increased their monthly contribution to the English and French total supplies. In April the total supplies touched their record figures of 27,155 tons, and again in June the total was 26,870 tons. The diminution in the total for July (21,226 tons) is thus seen to be considerable. Deliveries in July have amounted to 21,201 tons, and 375 tons "Standard" copper have been shipped to America. The fall in stocks from 29,263 tons on June 30th to 28,913 tons on July 31st, is therefore slight, and hardly accounts for the advance in price from £71 15s. to £73 during the month. No new copper mining companies have been floated in London during July.

Diatrine Cables.—We understand that Messrs. W. T. Glover & Co., Limited, of Trafford Park, Manchester, have secured from the Manchester Corporation a large order for their Diatrine paper cables.

Electric Railway Signalling.—The Glasgow and South-Western Railway Company have decided to adopt a new system of train signalling known as Sykes' Electric Lock and Block System, for double-line working. It will be fitted up between Shields Road and St. Enoch Station to control the heavy traffic now dealt with.

Electrical Pump for Sinking Purposes.—According to the *Colliery Guardian*, the Jeanesville Ironworks Company, of Pennsylvania, have brought out a convenient form of electric pump for sinking operations, that can be lowered into the pit in the same way as the Pulsometer steam pump is lowered, the electric pump only requiring a pair of cables for the supply of energy, in place of the steam pipes necessary with steam pumps. The Jeanesville pump consists of the ordinary three-throw pump, made in a convenient form, and mounted on one casting. Above the pump proper is a second casting, containing the shafting and reducing gear, and above this again is a third casting, containing an enclosed electric motor, with starting gear. The three castings are bolted together so as to form one iron case, with the necessary arrangements on the outside for connecting to the electrical supply cables, and to the pumps, and for suspending the apparatus in the pit and raising and lowering it as required. The pump is made in different sizes, ranging from 3½ inches diameter × 8 inches stroke in the pump barrels, occupying a space of 25 inches × 31 inches × 7 inches, up to 5½ inches diameter × 8 inches stroke in the pump barrels, occupying a space of 38 inches × 39 inches × 10 inches.

Electrically-Driven Tools.—Messrs. Jas. Clark, jun., and Co., of Louisville, U.S.A., send us a nicely got-up booklet on the important subject of electrically-driven tools, of which the firm makes a speciality. The illustrations, which are accompanied by brief descriptions and tables of dimensions, include a sensitive drill, automatic "shop" saw, 30-inch semi-radial drill, tool and centre grinders, and semi-enclosed motor of ½ to 5 H.P. The designs shown forcibly illustrate the revolution which is beginning to take place in shop work, consequent on the adoption of electric power.

Electricity in Printing Works.—W. Rapp & Sons, publishers and printers at Saltburn, have installed electric light throughout their extensive premises, and have laid down electric motors to drive their printing machines.

Insulating Gloves.—According to *L'Indépendance Belge*, a prize of £46 is offered by the French Accidents to Workmen Assurance Association, to the inventor who shall produce a glove that can be used by electrical workmen to safeguard them from accident. The conditions are that the glove must cover the forearm as well as the hands; that they must be light, and leave the utmost liberty to the fingers. If one specification does not come up to the required standard, the prize will be divided among those inventors who most nearly approach it, the decision being left with a special commission nominated by the association.

Manhole Cover.—An ingenious waterproof cover, called the "Faller Manhole Cover," has been patented, in which a double water seal is used, confining a column of air under slight pressure between the two, with the object of keeping water out of the manhole without any other kind of packing. The operation of opening or closing the manhole is exceedingly simple and quick. The invention is in the hands of Mr. J. W. Chisholm, of Washington, U.S.A.

Mill Installation.—Messrs. Ellis & Ward, of Birmingham, have secured the contract for the complete electric lighting and power plant for the new mills for Messrs. M. Wright & Sons, in Leicestershire. The generators will have an output of 100 KW.

Motor Trucks.—Illustrations of a line of motor trucks are sent us by the McGuire Manufacturing Company, of Chicago, U.S.A. The design of these trucks is somewhat different from that to which we have grown accustomed, the frame, instead of being built up, being formed of solid steel castings. This construction gives the trucks a very massive appearance, though they are not necessarily heavy, and the number of parts is much reduced. The illustrations comprise ordinary and maximum traction trucks for bogie cars, as well as trucks for four-wheel cars, combination mow, plough and sweeper, a patent fender, stoves, watering cars or "sprinklers," &c.

The New South Station, Boston.—A paper read by Mr. Walter C. Kerr before the American Society of Mechanical Engineers, New York, in which a full and clearly written account is given of this large, well-equipped railway station, has been re-printed and issued in the form of an attractive booklet by the British Westinghouse Electric and Manufacturing Company, Limited. At the close of last year 737 trains were entering and leaving the new station daily, 65 of these within an hour in several instances, and in one case six trains depart and three arrive in a space of time less than two minutes. We gave an illustrated description, in Vol. 45, p. 363, of the main features of the equipment, which was entirely supplied by the Westinghouse interests; it has been divided for the purpose of this article into 12 parts, each of which is dealt with in detail. These division are:—The power house, interlocking switch and signal system, the electric plant, heating and ventilation, disposal of drainage, roof drainage, ice making, refrigerating and water cooling plants, car heating in sheds and yards, air brake charging, steam and hot water supply, fire protection, baggage and express lifts and elevators. The article is well illustrated both from photographs and sectional drawings.

Smoke Nuisance.—At Lambeth last week the South London Electric Supply Corporation, Limited, of Bengeworth Road, Loughborough Junction, were summoned by the Lambeth Vestry for allowing black smoke to issue from the chimney shaft of their premises in such a quantity as to be a nuisance. Mr. Hopkins ordered the defendant company to pay a penalty of £10 and 2s. costs.

Trade Announcements.—To meet their increasing business in the Northern provinces, the British Thomson-Houston Company, Limited, have, in addition to other branch offices, opened a branch at Newcastle-on-Tyne, in the St. Nicholas Chambers, Amen Corner.

In order to cope with the various work in hand and their increasing business, Messrs. Crampton & Co., electrical engineers, Great Yarmouth, Cambridge, and Bury St. Edmunds, have opened offices at 77A, Queen Victoria Street, E.C., which will be used chiefly as the estimating department for country house lighting, complete plants, and power installations, in which work they specialise.

Messrs. Geipel & Lange, of Westminster, inform us that they have made arrangements to act as the exclusive agents for the United Kingdom for the Ward Leonard Electric Company's apparatus, and have placed in stock a large quantity of field rheostats, motor starters, automatic circuit breakers, and theatre dimmers. Lists may be obtained on application. The Ward Leonard Company has a comprehensive exhibit in the U.S. section of the Paris Exhibition.

Train Lighting.—A beautifully illustrated pamphlet reaches us from the Consolidated Railway Electric Lighting and Equipment Company, New York, U.S.A., describing their system of lighting trains, which is said to be the result of the consolidation of various companies interested in the subject. The system is called the Consolidated Axle Light System; each car is self-contained, and a complete outfit for one car weighs less than 1,000 lbs. The mechanism consists of a dynamo fixed beneath each car, and driven by belt from the axle; the pressure is automatically controlled at all speeds. Below a speed of 15 miles per hour the lamps are fed by a storage battery; above that speed the dynamo is switched on, and the battery used as a regulator. The usual automatic reversing switch and battery cut-out are provided, and a resistance is inserted in series with the lamps when the battery is being charged in parallel with them. From 17 to 80 16-C.P. lamps are installed on each car, with from two to eight electric fans. As will be seen, the arrangement resembles the "Stone" system, in use in this country, except in the method of controlling the pressure of the dynamo.

Wiring Tables.—A new book of wiring tables of small enough size to put into the waistcoat pocket, and comprising some 30 new and original tables for practical use, will be issued "soon after the holidays." The author is Mr. W. Perren Maycock, M.I E.E., and the publishers, Whittaker & Co.

Wolverhampton.—On the occasion of the visit of T.R.H. The Duke and Duchess of York to Wolverhampton last week, the electrical illuminations of the town were entrusted to Messrs. Read & Jenkins, electrical engineers, Gloucester, who carried out extensive illuminations in Dudley Street, the Art Gallery, Town Hall, Free Library and in other places, the number of lamps installed being between two and three thousand. The whole of the work was done in four days, under the personal supervision of Mr. R. F. Read, A.I.E.E., with entire satisfaction to the Corporation and townspeople. Messrs. Read & Jenkins also illuminated Bristol in November last when Her Majesty the Queen visited the town.

ELECTRIC LIGHT AND POWER NOTES.

Bavaria.—A syndicate has been formed at Ochsenfurt, Bavaria, to apply electricity in agriculture. A central station will furnish the current at a pressure of 5,000 volts to small stations on each farm for working thrashers, cutters, and so on. The houses in the vicinity will also be lighted by it.

Belfast.—The electric light accounts for the six months ending June 30th, 1900, show that the total energy used in that time was 351,641 units, as against 244,589 units at the same date in 1899, being an increase of 43·8 per cent. The total energy sold for lighting was 294,759, against 213,727, being an increase of 81,032 units, or 38 per cent.; and for motor use 56,882, against 30,862, being an increase of 26,020, or 84·4 per cent. In its report the Electricity Committee placed on record its appreciation of the able and courteous manner in which Mr. V. A. H. M'Cowen discharged his duties as chief engineer.

Blackburn.—The accounts of the borough treasurer for the past year show that the Corporation's electrical undertaking yielded £10,769 for energy, other sundry receipts making the total income £11,483. After paying working expenses, interest, and sinking fund there is a small credit balance of £19. The tramway account shows a loss on the year's working of £4,565, but considerable outlay has been made which will not be incurred in future years.

Carmarthen.—The Town Council has decided to obtain the advice of an expert in the electric lighting of the borough.

Chelmsford.—The Town Council has renewed its contract for public lighting with the electric lighting company, at the rate of £25 5s. per arc lamp and £3 3s. per incandescent lamp per annum.

Cheltenham.—An order for an extension of the Cheltenham electric lighting area into the adjoining Local Board district of Charlton Kings was included in an Act of Parliament, which received the Royal assent last week. The portion of Charlton Kings added to Cheltenham by the extension of its boundaries was included within the lighting area by a previous order; the whole of the parish of Charlton Kings is now therefore within the Cheltenham lighting area.

Crewe.—The Town Council has resolved to extend its electric lighting area, at a cost of £10,000.

Dewsbury.—At a meeting of the Town Council on Tuesday the following recommendation of the Electricity Committee was approved:—"That the charge for electricity for cooking, heating and motive power be increased from 3d. to 4d. per unit for electricity consumed for not exceeding an average of one hour per day on a consumer's maximum demand, and reduced to 1d. per unit for electricity consumed above that average." An application has been made by Messrs. B. Bullock, Limited, wholesale confectioners, for a supply of electricity for motive power. The Corporation have agreed to lay down the necessary mains subject to Messrs. Bullock, Limited, entering into a written agreement to take not less than 20,000 units during each of the next five years.

Elland.—The District Council's provisional order has received the Royal assent, and the Council is taking active steps to carry it into effect.

Guernsey.—The following particulars relating to Messrs. Edmundson's electrical undertaking were crowded out last week:—In the spring of 1897 the corporation applied to the States for a concession for the establishment of an electricity supply in Guernsey. The concession was granted in the spring, 1898, and the plans for the works were forthwith put in hand, and Mr. W. H. Druce, A.M.I.C.E., appointed engineer and manager for Messrs. Edmundsons in the island. Building operations were commenced early in 1899, Mr. J. H. Mansell, of St. Sampson's, being the chief contractor. No less than 4,000 tons of earth and rock had to be removed from the site before the foundations could be put in, owing to the slope of the ground, which also necessitated putting the floors at different levels, the engine room being 14 feet above the boiler house, and the accumulator room and private office 5 feet higher again. The chimney stack, which is 100 feet high, and 5 feet diameter inside, is built of brick, with a cap of granite. The rest of the buildings are built of local granite throughout, with the exception of the temporary ends. There are two Babcock & Wilcox water-tube boilers, each capable of evaporating 3,500 lbs. of water per hour at a pressure of 100 lbs. per square inch, and room is left for a new boiler double the size, which is to be delivered by October. This large boiler will be fitted with mechanical stokers. In the boiler house are also two feed pumps, one driven by steam and the other by an electric motor. Outside the boiler house is an economiser. There are at present two engines of 100 H.P., coupled direct to dynamos running at a speed of 500 revolutions per minute, capable of supplying 2,000 8-C.P. lamps each at full load. Room is left for two engines, each capable of supplying 5,000 lamps, one of which is to be erected this autumn. The switchboard is a very elaborate piece of work, made of Sicilian marble, and framed with a carved mahogany moulding. All of the instruments are made under Lord Kelvin's patents. The accumulators consist of 230 cells in glass boxes, and can supply 12,000 lamps for 12 hours when fully charged. The feeder and distributor cables, of which there are at present seven miles laid, are capable of supplying 10,000 lamps, so that the streets will not require to be opened again until the system has grown very considerably.

At the formal opening ceremony on July 25th, Mr. J. C. Wigham, chief engineer of the corporation, asked Sir T. Godfrey Carey, the Bailiff or Chief Magistrate of Guernsey, to inaugurate the works by setting the engines in motion, which he did—the light being turned on by Miss Carey, who was made the recipient of the suitably-inscribed handsome gilt switch, used on that occasion.

The Chief Magistrate, in a brief speech, complimented the corporation, thanked Mr. Wigham for his clear description of the plant and buildings, and declared the works formally inaugurated.

The company afterwards adjourned to the Yacht Hotel, where luncheon was served under the presidency of Sir T. Godfrey Carey, and a lengthy list of toasts was duly honoured. The managing director of Messrs. Edmundson's, Mr. Gripper, was unavoidably absent, having to give evidence that day before a Committee of the House of Lords with respect to the Lancashire power scheme.

Halesowen.—The District Council has placed a contract with the local gas company for public lighting, and at the same time has resolved to oppose the application of the Midland Electric Corporation for a provisional order.

Hull.—The Electric Lighting Committee last week reported that they had held a special meeting to consider the position of the Corporation with regard to Messrs. Earle's contract for two dynamos. The solicitors for the Vulcan Boiler Insurance Company, sureties for Messrs. Earle, suggested that the Corporation should agree to Messrs. Thomas Parker, Limited, supplying the dynamos, the Corporation paying the sum of £3,725 (the same amount as would be payable under Earle's contract), and their clients (the sureties) would pay the difference between that sum and the price charged by Messrs. Thomas Parker, Limited, which would amount to between £400 and £500. The Committee recommended the Council to sanction this course, which was agreed to.

Italy.—A plant is about to be established to utilise the water-power of the Varaita torrent at Venasia (Como) in the generation of electrical energy; a 30 years' concession in respect of the same having just been granted.

Kiel.—After experimenting with electric power transmission in the Government dockyard on a comparatively small scale with good results, the Administration have now decided upon a bolder scheme, whereby the whole of the machine tools, &c., installed in the different workshops are to be electrically driven. To this end a power plant, having a capacity of 3,500 H.P., is to be put down. This plant will also supply electrical energy for driving the powerful dockyard pumps.

King's Lynn.—The Town Council have received the sanction of the Local Government Board to the borrowing of the sum of £9,980 for extensions at the electric lighting works.

London.—The *Morning Post* for August 6th has the following:—"A strange and somewhat alarming spectacle was witnessed outside the *Morning Post* office soon after one o'clock yesterday morning. A sharp explosion occurred in one of the manholes employed in connection with the electric lighting mains laid under the pavement at this point, the iron cover was blown off, and a great burst of flame issued from the aperture. Police from Bow Street and firemen from the nearest fire stations were soon on the spot, but the flames which came from the highly combustible insulating material with which the electric wires are surrounded, continued to rise to the height of 10 feet or 12 feet for a considerable time. Representatives of the electric lighting company eventually severed the connections, and the fire burnt itself out. A stream of melting insulating composition made its way into the *Morning Post* machine room and damaged some of the paper stored there. Several feet of the asphalte foot pavement of the Strand were also destroyed, but apparently no other damage was done except to the electric mains themselves."

Whitechapel.—The District Board of Works last week decided to apply to the London County Council for further loans amounting to £55,000, making in all a total of £105,000, for completing the electric light installation in the district. The Board is now generating current for 60 arc street lamps, and is supplying 8,054 8-C.P. lamps for private consumers, while applications for 958 additional lamps have been received. The foundation stone of the new electricity supply station was laid by Mr. J. Harris, chairman of the Board of Works, on Thursday last week.

Maidenhead.—The Town Council having applied for sanction to borrow £25,000 for purposes of electric lighting, a Local Government Board inquiry was to be held by H. H. Law, Esq., M.Inst.C.E., on Wednesday last.

Malvern.—The District Council has instructed the surveyor to report on the question of supplying the town with the electric light and working in connection therewith a refuse destructor.

Manchester.—The City Council has resolved to send a deputation to the Paris Exhibition, consisting of four members of the Electricity Committee.

Montreal.—The Royal Electric Light Company, of Montreal, has just issued a most satisfactory report. The net earnings for the year amounted to $597,931, and after deducting fixed charges, the net profit for the year was $556,692.

Penang.—The Municipal Commissioners have voted a sum of Rs. 300,000 for the establishment of an electric lighting system in Penang.

Penistone.—The District Council has decided to meet the Penistone Board of Guardians and the Thurlstone Council to consider the advisability of installing electric light in the district.

Provisional Orders are to be sought for—

Padstow.—By Messrs. J. W. Manley & Co., Westminster. The District Council has a scheme of its own, and will not assent to the application.

Ross.—By Mr. J. Parker, of Hereford, on behalf of the Ross Electric Light and Power Company, Limited. The District Council will not oppose.

Rotherham.—The foundation stone of the electricity works was laid by the Mayor last week. Prof. Kennedy's scheme provides for both public and private lighting, on the three-wire direct current system, and for future traction supply.

Russia.—A syndicate has been formed to put down plants to utilise the water-power of the water falls of Imatra and Narowa, in Finland. It is proposed to transmit the electrical energy generated to St. Petersburg for lighting and power purposes.

Ryde.—A Local Government Board inquiry was to be held at Ryde on Wednesday last into the application by the Town Council for leave to borrow £30,000 for electric lighting purposes.

Saddleworth.—The Urban District Lighting Committee has resolved to recommend the adoption of an electrical scheme for lighting the area between Delph and Junction, or Denshaw, with electricity, and connecting the two places by an electrical tramway. Junction is three or four miles from Oldham, and the traffic of holiday makers through the village in summer time is enormous.

St. Helens.—The Gas and Lighting Committee has bought the Warrington Old Road electricity works, buildings and part of the machinery from the Electric Supply and Tramways Committee for £1,800. The remainder of the plant will be put up for sale.

Shipley.—Colonel Coke, R.E., Local Government Board Inspector, held an inquiry last Friday into the application of the Shipley District Council for leave to borrow £22,000 for electric lighting purposes. Mr. Quin, M.I.E.E., gave evidence as to the cost and probable income. Two 200-kw. steam dynamos, pumps, condensers, and switchboard would absorb £7,500; mains, street standards, £9,775; engineering and other expenses, £2,778; and a 10 per cent. allowance for contingencies made up the sum to £22,000. The income was estimated at £3,088, of which £3,003 was anticipated from lighting units at 5d. per unit. The working expenses, it was calculated, would amount to £1,191, which, with £1,553 for interest and sinking fund, made a sum of £2,744, leaving an annual balance of profit on the trade suggested by the canvass of £344. There was no opposition to the application. The intention of the Council in this scheme is to lay down two steam turbo-dynamos, which will give a continuous current at a pressure of from 460 to 500 volts. Each dynamo will also have a series winding on its field magnet to enable it to work as a compound machine for traction purposes at from 500 to 560 volts. A condenser of 10,000 lbs. capacity per hour will be installed, the water being obtained from the Leeds and Liverpool Canal, which passes close by the works. A storage battery will be provided to act as a reserve. The method of distribution will be the three-wire continuous current system, with 460 volts across the outers.

Stockport.—The Mayor, as chairman of the Gas and Electricity Committee, proposed the adoption of the report of the Committee, which stated that the net profit on the past year's working of the gas department had been £8,976, and on the electricity department £118 for the first 16 months. The Committee had resolved:—"That the price of current be modified by adopting the principle of differential charging, such charge to be at the rate of 5d. per unit for the first hour's daily capacity and 2½d. per unit for all current used in excess."

Stroud.—The Urban District Council will not approve of the application being made by the United Electric Light and Traction Company for a provisional order, but will itself take the matter in hand now that it has been aroused. The Council will forthwith make its application for an order.

Train Lighting.—The Caledonian Company has on hand 150 carriages and saloons of the most approved type. They were designed by the locomotive superintendent, Mr. John F. McIntosh, and will be far ahead of anything at present running in the kingdom. The carriages are to be lit by electricity, generated by a dynamo driven by a belt from one of the axles.

Tunbridge Wells.—The Town Council has resolved to build a new chimney at the electricity works at a cost of £3,500, together with a new flue and economiser costing £1,000. Application is to be made to the Local Government Board for leave to borrow £5,000 to carry out the work.

Uxbridge.—The Uxbridge Electric Light and Power Syndicate last week received the Royal assent to their provisional order.

ELECTRIC TRACTION NOTES.

Blackburn.—The Tramways Committee of the Blackburn Corporation have reported to the Town Council in favour of instructing the Parliamentary Committee to acquire powers enabling the construction of a tramway extending from Furthergate to the borough boundary in Burnley Road, where it would join the proposed light railway at present under consideration by the Light Railway Commissioners. The amount to be raised for this undertaking, providing the Town Council approve it, is £15,000.

Burnley.—At last week's Council meeting Mr. Alderman Armistead moved that, on the recommendation of the tramways company, the Council retain the services of Major P. Cardew, of the firm of Preece & Cardew, as consulting engineer to advise the Corporation with respect to the proposed electrical equipment of the tramways. He said they proposed to pay him 250 guineas, and 10 guineas for every day occupied in visits to Burnley, in addition to travelling expenses. He stated that the work of relaying and electrically equipping the same would be carried out under the direction of the borough surveyor and electrical engineer, and Major Cardew was being called in to advise them in the matter. Mr. Harker seconded, and the resolution was passed.

Carnarvon.—The Carnarvon Town Council have under consideration two or three electric light and railway schemes. Two rival syndicates are anxious to undertake the work, and the Council have interviewed the representatives of each. Mr. Peterson, solicitor, 56, Lincoln's Inn Fields, London, on behalf of his syndicate promised to obtain an order to construct a tramway from the Aber Bridge to Dinas Dinlle, and to construct a carriage road at the side of the tramway as far as Voryd, and a public bridge across the Voryd. The whole of the work is to be carried out at the expense of the syndicate, and nothing will be asked of the two Councils concerned (the Carnarvon Town Council and the Gwyrfai District Council), but their moral support. The syndicate, however, lay it down as imperative that they be permitted to establish an electric lighting installation at Carnarvon, and supply the town and the Gwyrfai district with electricity. They also promise to give their favourable consideration to the question of constructing a light railway from Ebenezer and Bethel to Carnarvon. Mr. Bennett, of the firm of Messrs. Bennett & Ward Thomas, of Manchester, promised to obtain an order to construct a light railway from Ebenezer to Carnarvon, and another from Carnarvon station to Dinas Dinlle; to pay half the cost of constructing a carriage road from Aber Bridge to Voryd, and a bridge across Voryd, each 22 feet wide, this matter to be reconsidered by his directors with the view to their undertaking to pay the whole cost of the road and bridge; to obtain powers to put up an electric lighting installation and refuse destructor at Carnarvon for the purpose of providing the necessary power for working the tramways by electricity, and also for town lighting purposes, but a contribution was expected from the Councils towards the proposed railways. A joint committee of the two Councils recommend the latter to favourably consider the proposals made by Mr. Peterson, and to give the committee power to further consider the details with him.

Derby.—At last week's Council meeting the Tramways Committee presented a scheme for reconstructing the existing tramways and also for extending existing routes and adopting new ones which have not previously had a tramway service, adding that they proposed to adopt electric traction for the whole. The approximate length of the present tramway is 4 miles 7 furlongs and 5·70 chains, and on the station route it is proposed to have double lines throughout with crossovers, whilst in the wide portions of several thoroughfares there will be centre standards. The new routes will be 13 miles 1 furlong and 2·21 chains in lengths, and in the majority of cases they will have single lines with passing places. Alderman F. Duesbury, chairman of the committee, in proposing the adoption of the report and scheme set out therein, reminded the Council that the tramways were purchased by the Corporation some two years ago with the idea that they should be brought up to date, and also that the present system was totally inadequate for the requirements of the large and growing population. The committee felt that, although they had power to spend something like £50,000 upon the present route in electric traction, it would be a piecemeal policy to go in for the existing route alone, and so they came before the Council with a complete scheme which would cover the whole length and breadth of the town. As far as possible, and wherever practicable, there would be double lines and the scheme would cost something like £200,000 in round figures. With regard to the generating station, they had not had a direct consultation with the Electric Light Committee on the subject, but they proposed to take powers for the compulsory acquisition of property on the south side of the baths in Tull Street and bounded on the north by the present electric light station, and erect buildings thereon for the purpose. Mr. A. Butterworth, J.P., chairman of the Electric Light Committee, strongly recommended the acquisition of the land in Tull Street for a generating station, because his committee would in the near future have to go in for an extension of their works, and this was the direction in which they would have to extend. In 12 months the capabilities of the electric light station would be exhausted, and therefore it would be better to acquire land for a generating station near the present works, so that they could extend them. It would also be better for the whole of the generating power for the electric light and the trams to be under one committee and under one responsible engineer. Alderman Doherty said it was the intention of the Tramways Committee to make use of the present engineer

and his staff, but they were not going into partnership with the Electric Light Committee. Other members spoke in support of the resolution, and in the end the scheme was unanimously adopted.

Dudley.—With respect to the extraordinary tramway dispute reported in the Electrical Review of last week, the Corporation have instructed their agent to make an application in the Chancery Division for an injunction to restrain the British Electric Traction Company from prosecuting the work which was the cause of the disturbance. The Town Council have decided that, whatever the result of the application, there shall be no further forcible opposition.

Eccles.—Messrs. Medhurst, Kitchen & Page, of Manchester, have been appointed to act as advisers to the Corporation in relation to reconstruction of the tramways and their adaptation to electrical traction. The Public Lighting and Electricity Committee is to take into consideration the advisability of supplying the electrical energy to work the tramways. It was decided to promote an Omnibus Bill in the next session of Parliament. Expert advice is to be obtained with a view to the alteration or extension of the existing electric light undertaking so as to supply the probable increased demand during the coming winter season.

Electric Railways in Canada.—According to figures compiled recently in the Statistical Department of the Dominion Government, travel on Canadian electric railways shows a very healthy growth, the number of passengers carried by the steam and electric railways of the country being 120,000,000, of which the electric roads carried 87 per cent. During the year ending with December 31st, 1899, the total number of miles run by cars over the 632 miles of this kind of track was 29,646,847, and the number of passengers carried was 104,033,659. This is an increase over the previous year of over half a million miles, and 9,500,000 passengers respectively. The amount of paid-up capital invested in electric railways was $21,700,000. The ratio of passengers carried per mile was 3½, compared with 3⅓ the previous year, and compared with 1½ only on steam railroads. It will not be long, says the *Monetary Times*, of Toronto, before we shall witness a very marked growth of this means of communication in Canada.

Germany.—Messrs. Kummer & Co., of Dresden, have secured a contract to construct an electric tramway between Laubegast, Leuben, Kleingschachurtz and Mugeln.

Hyderabad (Deccan).—Proposals have been made for making an electric tramway between Hyderabad and Secunderabad, combined with a service of electric light and power supply.

Leeds.—The Corporation Tramways Committee have decided to accept the offer of the British Westinghouse Electric and Manufacturing Company, Limited, to send an electric magnetic brake for a two months' trial, on condition that one of the company's representatives be in attendance during that period.

Liverpool.—At the City Coroner's Court on Tuesday, Mr. T. E. Sampson held an inquiry into the circumstances relating to the death of Christopher M'Gwin, 22 years of age, a labourer employed by the Corporation Tramways department. It appears that during the thunderstorm on Friday deceased was changing the tram horses in Robson Street, and was severely injured by an electric wire falling upon him. He died the same night at the Stanley Hospital. It does not appear whether the wire was blown down or broken by the lightning, or had broken through some defect in it. The inquest was adjourned until to-day for the purpose of getting expert evidence.

The Tramways Committee are asking the City Council to approve of a supplementary estimate on tramways capital account of £23,167 for the construction of additional lines for electric traction under the Liverpool Corporation Tramways Extension Order, 1900.

Another of the new electric tram routes in the city of Liverpool, that between Old Swan and the pierhead, the riverside terminus, was officially inspected on behalf of the Board of Trade, by Colonel Yorke, on Friday last. The inspection was satisfactory, and the route was opened for public traffic on Monday last. The distance from the pierhead terminus to that at Old Swan is a little more than three miles and a half. The through fare is 2d. The longest 1d. stage, from the pierhead to Sheil Road or *vice versa*, is two miles and a quarter. The cars begin to run at 5 a.m. and continue running until 11.30 p.m. Between 7.30 a.m. and 11.30 p.m. cars are run every three and a half minutes.

On Friday Colonel Yorke, on behalf of the Board of Trade, made an official inspection of the Seaforth and Crosby tram route, which runs in connection with the Overhead Railway. Mr. Trotter inspected the electrical portion of the line on June 19th.

Liverpool—Bootle.—The award of the Board of Trade arbitrator on the difference between Liverpool and Bootle concerning the rental of the electric tramway lines laid and equipped by the Bootle Corporation has been reported upon by the town clerk of Liverpool. The arrangement was—first, that the lines in Bootle should be laid by the Bootle Corporation and leased to the Corporation of Liverpool at an annual rent; second, that the electrical energy necessary to work them should be supplied by the Bootle Corporation. Difference arose on both points. The Tramways Committee offered a rental of £5,702 6s. 4d., or £1,551 less than the sum demanded. The arbitrator awarded £5,798 6s. 4d., the amount of the Tramways Committee's offer, plus £96 per annum for repairs to overhead wiring. With regard to electrical energy, the Bootle Corporation asked for a guarantee that the committee would take not less than 600,000 units. The arbitrator decided that 375,000 units should be supplied at 1½d. per unit; any further supply to be 1d. per unit. On the ground that the Liverpool Corporation ought to have begun the service as soon as the lines to and through Bootle were complete, the rental was fixed as beginning from April 1st last. The award also recommended that the lease should be for 25 and not 12 years; that the rental for the concluding term of 13 years should be £4,776 per annum, and that the fares charged in Bootle should be assimilated to those charged in Liverpool.

Middleton.—Arrangements are now almost complete between the Middleton Corporation and the British Electric Traction Company. These arrangements are that the tramway company shall take their power from the Corporation over the whole of their route—Chadderton to Middleton, Middleton to Manchester, and Middleton to Castleton. The points of difference are only matters of minor detail.

Morecambe.—Satisfactory trials have been made at Morecambe of new electric launches, which are the property of a syndicate. Arrangements have been made with the Urban District Council to supply energy at 3d. per unit. The pressure is 220 volts, but by means of a motor-generator close to the landing place the pressure is transformed to that required by the boats. The cables are then conveyed by an iron main laid underneath the stage to an iron standard erected above the ordinary high-water mark at the foot of the landing stage, where by means of cables attached to watertight boxes at the top of the standard the boats can be charged at their moorings. The manager is Mr. J. J. Hargreaves.

Nottingham.—Rapid progress is being made in the work of laying the new track in connection with the Nottingham Corporation electric tramway system. The first section, now in hand, is that from Sherwood to the Great Market Place, along the Mansfield Road, the widest and most attractive thoroughfare in the city, a distance of about a mile and a half. An electric power station is being built at Sherwood, and the work of laying the new metals was commenced about two months since. The old gauge is being adhered to, so that the newly-constructed track is available for the existing horse-traction cars. The scheme includes the reconstruction of all the existing tram lines in the city, and a number of important suburban extensions.

Oldham.—At the quarterly meeting of the Oldham Town Council on Wednesday last week it was decided to apply to the Board of Trade or other Government department for sanction to the Corporation borrowing £280,000 to cover the expenditure to be incurred by the Corporation in connection with the conversion to electrical operation of the existing tramways and the tramways authorised to be constructed by the Oldham Corporation Act of 1899, the purchase of cars and the erection of depôts, &c. Alderman Chadwick (vice-chairman of the Tramways Committee) stated that the total estimated cost of the tramway scheme amounted to £372,000. The tender of Messrs. W. T. Glover & Co., Limited, of Manchester, for the overhead and underground equipment of the tramways has been accepted.

Russia.—It is announced from Astrachan, on the Caspian Sea, that an electric tramway has just been completed and put in operation in that town. The St. Petersburg branch of Messrs. Siemens & Halske has supplied the plant at the power station, which comprises three 200-H.P. steam dynamos and a battery of boilers fired by liquid fuel.

Salford.—The Tramways Committee has passed a resolution authorising the expenditure of £90,000 for horse traction purposes pending the completion of the electrical system in the borough.

South Carnarvonshire.—The Carnarvonshire County Council last week had under consideration the plans deposited relating to the proposal to make a light railway (4 feet 8 inches gauge) on the main road between Pwllheli and Nevin. The promoters are the North Wales and District Light Railway and Electric Power Syndicate, Limited, and they applied for a loan of £5,500. The committee of the County Council approved of the proposal on condition that the promoters provided a roadway along the whole of the route of a width of not less than 19 feet 6 inches from the end of the sleepers to the foot of the hedge, and also that the top of the sleepers be made level with the roadway, and that all occupation and public crossings are paved. There was a long discussion on the question, and some opposition. A provisional agreement had been made with the Cambrian Railway Company to work the railway on receipt of 60 per cent. of the receipts. The Lord-Lieutenant opposed the project, but he only found two supporters. Mr. D. Lloyd George, M.P., overturned the Lord-Lieutenant's arguments in a very admirable speech in favour of the scheme, and the Council decided to vote the money, and to support the application of the company at the inquiry.

Staffordshire.—At a meeting of the Staffordshire County Council on Tuesday, the County Lunacy Commissioners reported that £3,800 was required for the formation and equipment of an electric tramway for goods and passengers from Cheddleton Junction up to the Asylum buildings. The report was adopted.

Valentia (Spain).—From a neatly printed *brochure* issued by the Société Anonyme "Electricité et Hydraulique," of Charleroi, we gather some particulars of the tramways, 40 km. in length, which the above company is converting to electrical working in and about Valentia. The population of this ancient city is about 250,000, and its trade is very important. The tramways up to lately

belonged to five companies, four of which, amalgamating, formed the "Cie. Générale," and embraced the principle of electric traction. There are four Mathol & Bailly water-tube boilers at the generating station, each having 135 tubes, with a heating surface of 213 m², and evaporating 2,800 kg. of water per hour at a pressure of 8 kg. per cm². The engines are of the Bollinckx horizontal compound type, four in number, and of 300 B.H.P. each at normal full load, 400 H.P. on overload; the cylinders are 500 and 800 mm. diameter, with a stroke of 1 m. The fly-wheels are 6 m. diameter, weighing 16 metric tons each, and run at 75 revolutions per minute. The consumption of steam is guaranteed not to exceed 6 kg. per H.P.-hour at full load. The dynamos are of 200 KW. output, at 550 volts, 450 revolutions per minute; they are six-polar, and have pulleys 1 m. diameter for driving by rope from the fly-wheels of the engines. The switchboard consists of four generator panels and two feeder panels, one at each end, positive and negative. The latter provides for the control of a motor-driven negative booster, which carries 800 amperes with a boost of 50 volts. Double trolley wire is used everywhere, the current being collected from them by a a sliding bow, movable about a vertical axis. The rails, which are joined with Chicago bonds, are of the Demerbe type, of various sizes and weights, and give excellent results. The cars carry 18 passengers seated and 15 standing, and weigh 6½ metric tons when empty. Each is equipped with two E.H.T.s 30-H.P. motors, with side bar suspension. Since its inauguration the service has proved very popular, and the receipts of the Cie Générale have very considerably increased.

Walker.—The new Tramways Committee of the Newcastle Corporation have under consideration the desirability of entering into an arrangement with the Walker Council for the extension of the Corporation tramways into the urban district of Walker, and have appointed a sub-committee.

Wigan.—The construction of the electric tramways commenced on June 11th, and has since made satisfactory progress. At the Council meeting last week, it was ordered that the seal be affixed to an agreement between the Leeds and Liverpool Canal Company and the Corporation as to the construction of a basin and other works at the electric light works.

Wrexham.—The Wrexham Tramways, Limited, have notified the Council that application was about to be made to the Board of Trade asking that the time limit for the commencement of the works authorised by the Wrexham District Tramways Order, 1899, be extended to August 1st, 1901, and that the time limit for the completion of such works be extended to August 1st, 1902. The Council, while protesting against the proposed application for extension of time without any reason being assigned, and when the Corporation were incurring heavy expenditure for providing motor power under the terms of the company's provisional order, will not in the present instance make any representation to the Board of Trade, but would offer strenuous opposition to any further application.

TELEGRAPH AND TELEPHONE NOTES.

Glasgow Telephones.—"A Citizen" writes to the *Glasgow Mail* drawing attention to a proposal by Mr. A. R. Bennett, as general manager of the Corporation Telephone Department, to pledge the Corporation "to give four months' free use of municipal telephones to certain people as an inducement to give up dealing with a commercial firm (who are taxpayers), and get supplied by this new trading department of the Town Council."

Jersey.—One of the assistant engineers of the National Telephone Company, Limited (Mr. Phillips), has been visiting Jersey regarding the laying of underground wires, a Bill with respect to which is now before the Legislative Assembly of the Island. The local manager of the National Telephone Company, Mr. John Lemon, has been remarkably successful in developing the system in Jersey, especially since the introduction of low rates.

New Atlantic Cable.—The Commercial Cable Company's new cable from the Azores to New York, *via* Novia Scotia, has been successfully laid by the cable steamers *Faraday* and *Silvertown* and is now completed and in working order. This line, which forms the Commercial Company's fourth Atlantic cable, will connect at the Azores with the system of the Europe and Azores Telegraph Company, and was opened for business on August 1st.

Paris—Berlin Telephones.—The *Times* says that the telephone is now in operation between Paris and Berlin, the rate being 6 francs per three minutes.

Postal Telegraphists and the Liberal Party.—A deputation consisting of Postal telegraphists and other Postal workers waited upon Sir Henry Campbell-Bannerman, M.P., on Friday, July 27th. The members of the deputation were Mr. S. W. Belderson, Mr. Churchfield, and Mr. W. E. Clery. The Leader of the Liberal Party was accompanied by his secretary, Captain Sinclair, M.P., and the deputation was introduced by Mr. S. Woods, M.P., and Mr. W. C. Steadman, M.P. The object of the interview was to lay before Sir Henry the grievances under which telegraphists and other Postal workers suffer, and to elicit from him some promise of support on behalf of his party. The points dealt with were the restriction of civil and political rights by means of Departmental and Treasury regulations; the failure of the Post Office to recognise and allow the full rights of combination among its employés; and the desire of all sections of the service for a full and impartial Parliamentary inquiry into the whole of the questions with a view to a more permanent settlement. The questions were fully explained by the three delegates, who pointed out that they represented a voting power of 40,000 votes, and the main direction of those votes would largely depend on the assurances received upon the various matters raised. Cases were quoted where departmental action ran counter to the express statements of Postmasters-General and their representatives, and where the rights of combination alleged to be in existence in the Post Office were infringed. Sir Henry Campbell-Bannerman, in reply, frankly confessed his inability to promise a definite line of action for his party, but expressed his sympathy with the desire that the legal rights of the employés should not be interfered with by the Postal Department upon any consideration. He did not think civil servants should be allowed to take an active part in political matters, but gave no reasons in support of his opinion. With regard to the rights of combination and the alleged refusal to receive union officials as representatives of the men, he said he did not think the rule that shut out the best informed men a very sensible one. If he were head of a department, he would not be "too fastidious." There were different ways of doing things, some formal and some less formal. His object would be to get a contented service. "As to speaking for the Liberal Party," he said, "I do not know that I have any great authority for doing so. I find sometimes I do not meet with great success in so doing." So he could not pledge his party to give a Parliamentary Committee of Inquiry. The deputation then withdrew.

Telegraphic Interruptions and Repairs:—

Cables.	Interrupted.	Repaired
South American:—		
Cayenne-Pinheiro	Oct. 11, 1899	
Pará-Maranham	March 1, 1900	
Ceará-Maranham	Feb. 20, 1900	
Iquique-Valparaiso	Aug. 2, 1900	
Serena-Valparaiso	Aug. 2, 1900	Aug. 7, 1900
West Indies:—		
Mo'e St. Nicholas-Cape Haitien	March 6, 1900	
Latakia-Cyprus	June 20, 1899	
Tarifa-Tangier	Jan. 3, 1900	
Landlines:—		
Chinese:—		
Tientsin-Pekin	June 12, 1900	
Pekin-Kalgan	June 14, 1900	
Kalgan-Maimatchin	June 30, 1900	
Tientsin, *via* Shanghai	June 16, 1900	
Tientsin-Ninchwang	June 18, 1900	
South American:—		
Communications with all offices of Columbia beyond Buenaventura	January 23, 1900.	
Ecuador landlines	March 13, 1897	
Landlines south of Macahé (Brazil)	April 25, 1900	
Landlines south of Serena	July 30, 1900	
West Indies:—		
Communication with interior of Haiti	July 29, 1900	Aug. 2, 1900
" " " "	Aug. 3, 1900	Aug. 4, 1900
Communication "*via* Hanekine" interrupted on Persian territory	Feb. 24, 1900	
Saigon-Bangkok	July 30, 1900	Aug. 3, 1900

CONTRACTS OPEN AND CLOSED.

OPEN.

Aarhus, Denmark.—The municipal electrical works are wanting "200 pieces electro-meters." For particulars see "Official Notices" July 20th.

Accrington.—The Corporation wants tenders for the supply of electricity meters. See "Official Notices" August 3rd.

Aberdeen.—August 25th. The Corporation invites tenders for steel poles, bases and brackets, for tramway equipment. See "Official Notices" to-day.

Barnes.—August 14th. The Urban District Council is inviting tenders for the supply of pipework, condensers, and overhead traveller. Specifications from the Surveyor, Council Offices, High Street, Mortlake. Deposit, one guinea.

Belfast.—August 15th. The Electric Committee wants tenders for an auxiliary feed-water heater and piping. See "Official Notices" July 27th.

Bradford.—August 13th. The Guardians of the Bradford Union want tenders for the electric lighting of the workhouse. See "Official Notices" July 27th.

Brussels.—September 19th. The Council of St. Jilles, lez Bruxelles, invites tenders for the installation and the commencement of supply upon a part of its territory. Conditions and plan for three francs at the office, No. 14, Parvis St. Jilles, St. Jilles.

Budapest.—October 15th. The Hungarian Minister of Commerce is prepared to receive tenders for the installation of two telephone exchanges, local and interurban, complete in all respects. See "Official Notices" August 3rd.

Cupar.—An electric light installation of about 800 lights is required for the Fife and Kinross District Lunatic Asylum. Application for particulars should be made to the Clerk of the Board, Cupar, Fife.

Dorking.—The District Council are open to receive offers for leasing their provisional order. See "Official Notices" July 20th.

Edinburgh. — August 13th. The Corporation wants tenders for coal-conveying machinery for Dewar Place station. See "Official Notices" August 3rd.

Fulham.—The Vestry wants tenders for electric wiring at the Town Hall, Walham Green. See "Official Notices" to-day.

Germany.—September 10th. — The Hamburg Finance Deputation is inviting tenders for the supply and erection of two 30-ton electric cranes. Particulars may be obtained for 3s. from the Secretariat II. der Finanz Deputation (Rathhaus Ober-Erdgeschoss, Zimmer 429), and tenders marked 339 are to be sent to Die Finanz Deputation, Hamburg.

Grimsby.—August 18th. The Corporation wants tenders for the supply of a steam engine and dynamo, and extension of switchboard. See "Official Notices" to-day.

Halifax.—Tenders are invited by the Town Council for mechanical stokers. See "Official Notices" July 27th.

Halifax.—The Corporation wants tenders for the supply of incandescent lamps. See "Official Notices" August 3rd.

Leeds.—The Corporation wants tenders for the purchase of second-hand machinery, at present in use in connection with the electric tramways. See "Official Notices" August 3rd.

Leeds.—August 14th. The Poor Law Guardians invite tenders for the electric installation of their offices in East Parade. Specifications, &c., obtainable from Messrs. Butler, Wilson and Oglesby, architects, 12, East Parade, Leeds. Applications to James H. Ford, clerk.

London.—August 14th.— The South London Electric Supply Corporation, Limited, invites tenders for condensing plant and cooling tower. See "Official Notices" August 3rd.

London.—August 20th. The Central Electric Supply Company wants tenders for boilers and piping, and mechanical stokers. See "Official Notices" July 27th.

London County Council.—September 22nd. Tenders are wanted for boilers, engines, dynamos, &c., at the Horton Estate, Epsom, Surrey. See "Official Notices" to-day.

Luton.—September 14th. The Town Council invites tenders for watt-hour and demand meters. See "Official Notices" August 3rd.

Madrid.—August 18th. Tenders are invited by the Spanish Government, not later than August 18th, for the concession of a system of electric tramway lines in Barcelona. Some particulars may be examined at the commercial department of the Foreign Office between 11 a.m. and 5 p.m.

Newcastle-on-Tyne.—August 22nd. The Corporation wants tenders for laying five miles of double-line tramway. See "Official Notices" August 3rd.

Newport (Mon.).—August 22nd. The Guardians want tenders for lighting the workhouse. See "Official Notices" to-day.

Plumstead.—September 19th. The Vestry wants tenders for boilers, refuse destructor, steam fittings, economiser; steam piping, pumps, &c., &c.; steam generators—two 300-I.H.P.; two 150-I.H.P.; and one 100-I.H.P.; condensing plant, cooling tower, &c.; switchboard; battery; traveller; mains, meters, arc lamps and posts, &c. See "Official Notices" to-day.

Portsmouth.—August 15th. The Electric Lighting Committee wants tenders for street work for laying cables. Specifications on application at the Generating Station, Gun Wharf Road.

Portsmouth.—September 4th. The Corporation wants tenders for the complete equipment of the tramway power station. See "Official Notices" August 3rd.

Salford.—August 13th. The Corporation wants tenders for lighting cables, tramway feeders, and street lighting. See "Official Notices" July 13th.

Salford.—September 3rd. The Corporation wants tenders for a lighting switchboard, traction ditto, and balancing transformers. See "Official Notices" to-day.

Spain.—August 24th. Tenders are being invited until the 24th inst. for the establishment and working of a telephone exchange in the town of Ciudad Real. Particulars may be obtained from, and tenders are to be sent to, El Gobierno Civil de la Provincia de Ciudad Real, Spain.

Stockport.—August 31st. The Tramways Committee wants tenders for 20 double-deck tramcars with electrical equipments. See "Official Notices" July 13th.

The Pacific Cable.—August 14th. Tenders for the manufacture and laying in the Pacific Ocean of 8,272 nautical miles of telegraph cable are invited by the Pacific Cable Committee on behalf of Her Majesty's Government and the Governments of Canada, New South Wales, Victoria, New Zealand, and Queensland. See "Official Notices" July 20th.

Warrington.—The Corporation wants tenders for electric light installations in certain buildings. See "Official Notices" August 3rd.

Warsaw.—August 28th. The Secretary of State for Foreign Affairs has received a despatch from Her Majesty's Acting Consul-General at Warsaw stating that tenders are invited by the Russian Government, not later than the 28th prox., for the telephone service of Warsaw, St. Petersburg, Moscow, Odessa, and Riga. Some particulars may be examined at the Commercial Department of the Foreign Office between 11 a.m. and 5 p.m.

Whitby.—September 3rd. The Council wants tenders for the supply of two water-tube boilers, pumps, condensers, pipes, &c.; two steam dynamos, balancer, and boosters; switchboard and connections; battery; travelling crane; cables, arc lamps, &c. See "Official Notices" to-day.

CLOSED.

Bootle.—The Town Council have accepted the tender of Callender's Cable and Construction Company, Limited, to supply and erect the arc lamps, cables, &c., required for the electric lighting of Derby, Rimrose, and Knowsley Roads, for the sum of £6,855 1s. 5d., together with a further sum of £80 per annum for the maintenance of the cables for 10 years.

Derby.—The contract for lighting the Infectious Diseases Hospital with electricity has been placed in the hands of Messrs. Newton Bros., of that town.

Glasgow.—The Corporation has placed contracts for carbons for the street lamps with the International Electric Company and the General Electric Company, Limited, for 100,000 pairs each.

Hull.—The *Contract Journal* gives the following list of tenders submitted to the Corporation for electric light installation and fittings for the Springhead pumping station, near Hull:—

Walsall Electrical Company, Liverpool (accepted)	£210 0 0
Lummis, Paterson & Co., Newcastle	216 0 0
Morley Electrical Engineering Company	225 0 0
Porte, Sykes & Co., Dublin	265 0 0
Reame, Wokes & Co., Hull	265 0 0
Keighley Electrical Engineering Company	275 0 0
King & Co., Hull	293 17 6
Corlett Electrical Company, Limited, Wigan	302 0 0
Concentric General Contract Company, London	305 0 0
Blanchard & Co., Hull	310 0 0
Blanchard & Co.	335 0 0
Crowther & Co., Manchester	350 0 0
Lighting Corporation, Limited, London	393 19 10
Handley & Shanks, Birmingham	503 8 0

Kingston-on-Thames.—The Corporation of Kingston-on-Thames last week accepted the following tenders relating to their electricity works:—Smokeless coal, Messrs. Phillips & Co., 1,400 tons, at 29s.; small coal, Dinham, Fawcus & Co., 2,200 tons, at 17s. 5d. (ex steamer); foundations for new boiler house, Mr. Stephen Kavanagh, £694 17s. 6d.; brickwork and setting for boilers, Messrs. Babcock & Wilcox, £960; steam main, valves and feed pump, same firm, £807.

Liverpool.—The City Council has placed a contract with Messrs. Willans & Robinson for three sets of plant, similar to those already ordered for the Lister Drive and Pumpfields electricity works, for £6,939 per set.

Rochdale.—The Council has given the contract for electric lighting at the Technical School to Messrs. Thomas Brown and Sons.

FORTHCOMING EVENTS.

Monday, August 13th to 17th.—Summer meeting of the Institution of Junior Engineers at Newcastle-on-Tyne:—

Monday, August 13th.—Reception at the Town Hall by the Mayor; visit Messrs. Swan & Hunter's works; and the works of the Electric Supply Company.

Tuesday.—Visit Messrs. Sir W. G. Armstrong, Whitworth & Co.'s Elswick Works; the Engineering Department of the Durham College of Science; and the works of the Newcastle and Dis rict Electric L ghting Company.

Wednesday.—Trip on the river to inspect the Tyne Improvement Commissioners' works.

Thursday.—Excursion to Sunderland to inspect the works of the River Wear Commission.

Friday.—Visit the Allhusen works of the United Alkali Company; the preliminary works of the Corporation's electric tramway undertaking; summer dinner in evening at the County Hotel, the president, the Hon. Charles A. Parsons, F.R.S., in the chair.

NOTES.

Röntgen Society of the United States. — The Röntgen Society of the United States is to meet in New York City on December 13th and 14th, 1900, at the Academy of Medicine. Notices, which have been sent out, state that papers have been promised by eminent men in America and abroad, and a very successful scientific meeting is assured. There will be offered advantages to the visiting members for instruction in X-ray work that cannot be had under any other conditions.

The Belleville Boiler.—Mr. Goschen has now given the composition of the Committee to consider this question. The members so far are Vice-Admiral Sir Compton Domville; Mr. List, the superintending engineer of the Castle Line; Mr. Bain, the superintending engineer of the Cunard Line; Mr. Milton, of Lloyds; Prof. Kennedy; an inspector of machinery of the Royal Navy, and some other person not yet known. The list looks all right. The Admiral we do not know. The mercantile marine is well represented in Messrs. List and Bain. Prof. Kennedy, as is well known, is a thorough advocate for the water-tube boiler which he has put in right and left, quite irrespective of any consideration for the cheapest fuel available being bituminous, and therefore not suited for water-tube boilers, but we have yet to learn he ever advocated any such boiler as one on the lines of the Belleville. The *Morning Post* finds fault with the Committee as not having the necessary knowledge. It does not think they will be able to appreciate the needs of the protective deck in warships. The protective deck necessitates engines with short stroke. Ocean liners have engines with "unlimited stroke." Therefore the liner engineers are unfitted to judge of Belleville boilers as though there were any connection between engine stroke and boiler. Yet, says our daily contemporary, the protective deck is a necessity obvious to everyone. If so obvious to *everyone*, it is possible that even the Committee may grasp its necessity and requirements. As usual with the daily press, the whole question of water-tube boilers is mixed up with the Belleville in particular. The *Hyacinth* is to be at the disposal of the Committee, and they are also to find out why the *Europa* failed so badly. If it does its work well the Committee will have its hands full, and should produce a valuable Blue-book on the subject. We hope it will be thorough and independent, for it is high time that the Navy was put into a state of efficiency. It must not only be the *biggest* but the *best* in the world.

Visit of American Institute of Electrical Engineers. —The river party to which the American guests of the Institution of Electrical Engineers are invited, will be given at Henley, electric launches taking a short run (probably to Shiplake and back) before the lunch, which will be at the Red Lion; after lunch the party will proceed to Boulter's Lock by launch, and will return to town by train from Maidenhead. The dinner on August 13th will be at 7 for 7.30 p.m., at the Princes' Restaurant, Piccadilly. During the morning of the same day, visits will be made to the laboratories of the Board of Trade, or (alternatively) to the Telegraph Department of the General Post Office, and in the afternoon to the Central London Railway, and to the Davies Street Station of the Westminster Electric Supply Corporation. On August 14th the party will visit the School of Military Engineering, and the Royal Dockyard at Chatham, and will partake of the hospitality of the Royal Engineers' Mess at lunch. The members of the party have been most kindly invited to a reception by Lady Fraser in the afternoon.

Electric Trams at Southend.—The Town Council yesterday accepted the tender of a London and Philadelphia firm, at £87,500, for certain work in connection with the establishment of the electric tramways.

Royal Assent.—The Royal assent has been given to the following Bills:—

Tramways Orders Confirmation (No. 1) Act, 1900.
Tramways Orders Confirmation (No. 2) Act, 1900.
Tramways Orders Confirmation (No. 3) Act, 1900.
Tramways Orders Confirmation (No. 4) Act, 1900.
Electric Lighting Orders Confirmation (No. 10) Act, 1900.
Tramways Orders Confirmation (No. 5) Act, 1900.
Blackpool, St. Anne's and Lytham Tramways Act, 1900.
Ipswich Corporation (Tramways, &c.) Act, 1900.
Salford Corporation Act, 1900.
Sheffield Corporation Act, 1900.
Baker Street and Waterloo Railway Act, 1900.
Bradford Corporation (Tramways, Gas, and Various Powers) Act, 1900.
Charing Cross and Strand Electricity Supply Corporation, Limited (Further Powers) Act, 1900.
County of Durham Electric Power Supply Act, 1900.
Halifax Corporation Act, 1900.
Lancashire Electric Power Act, 1900.
Lancaster Corporation Act, 1900.
Liverpool Corporation Act, 1900.
London County Tramways (Electrical Power) Act, 1900.
Newcastle-upon-Tyne Electric Supply Company's Act, 1900.
Oldham Corporation Act, 1900.
South Lancashire Tramways Act, 1900.
West Bromwich Corporation Act, 1900.
West Ham Corporation Act, 1900.
London, Walthamstow and Epping Forest Railway (Abandonment) Act, 1900.
Christchurch and Bournemouth Tramways Act, 1900.
Coventry Corporation Act, 1900.
Devonport Corporation Act, 1900.
Dublin Corporation Act, 1900.
Hastings Corporation Act, 1900.
Huddersfield Corporation Tramways Act, 1900.
London County Tramways Act, 1900.
London United Tramways Act, 1900.
Metropolitan District Railway Act, 1900.
North Metropolitan Electric Power Supply Act, 1900.
Plymouth, Stonehouse, and Devonport Tramways Act, 1900.
Rochdale Corporation Act, 1900.
Southport and Lytham Tramroad Act, 1900.
Southport Corporation Act, 1900.
South Wales Electrical Power Distribution Company Act, 1900.
Liverpool Overhead Railway Act, 1900.

Institution of Electrical Engineers—Students' Grants.—The Council has awarded the promised grant of £5 towards the expenses of a visit to the Paris Exhibition, announced in a previous issue of this journal, to each of the following students of the Institution:—

J. F. Avila	R. L. Pearson
A. Buckney	M. Solomon
F. H. Clough	C. T. Stephenson
R. Fisher	H. J. Thomson
A. J. L. Hurst	W. A. Toppin
J. T. Irwin	A. J. Tracey
T. L. James	S. A. Tunbridge
F. K. Jewson	G. E. Turnbull
L. R Lester	J. H. West
C. N. Nettley	F. P. Whitaker

The Nernst Lamp.—As the New York *Electrical Review* remarks, we hear very little to-day about the Nernst lamp. The hopes that were raised to a high point by the announcement of Dr. Nernst's interesting invention have seemingly withered, and, continues our contemporary, outside of the Paris Exposition, there does not seem to be a single installation of the new lamps in existence. There can be no doubt that the direction indicated by the German inventor is one that it would be profitable to follow. An increase in the efficiency of transforming devices for electric lighting would produce a highly desirable condition of affairs and greatly aid in the extension of such lighting in places where it is now considered too expensive. The fact that those of us interested in electrical matters know that electric light is not expensive as compared with gas or other illuminants is of little importanee, so long as the majority of the public are firmly convinced that an electric light is a luxury. As a matter of fact, in cities, it is a necessity, and as such is recognised by the more intelligent portion of the people. Still, any revolutionary invention that would tend to cheapen electric light service would make this variety of light more popular, and would go further toward driving the gas companies into their proper position—that of supplying a convenient source of small power and heat.

Electric Railways in America.—Our New York namesake delivers itself as follows :—"It seems strange that in all the building of electric railways which is now going on in the United States, not one single polyphase system has been installed. We have numerous and increasing examples of combination systems in which polyphase currents are generated at a central point and transmitted at high tension to sub-stations and there redistributed as direct current to the line. If it were possible to construct motors and car equipments using a polyphase source of supply directly, all of the expense and complexity of the sub-station could be avoided, and a highly efficient and a highly satisfactory variety of distribution secured that would make easy the somewhat difficult problem of long-distance electric railroading. All of the European experiments that have been made in this direction have met with a flattering degree of success, and it seems time, certainly, that American engineers should take up the question of the direct application of this variety of current to car motors. It seems as if the time is ripe, for the simplicity, mechanical strength, high efficiency, and other desirable qualities of the induction motor lend themselves with peculiar readiness to electric railroad work. It is probable that there are difficulties connected with the starting of such motors under load, but these difficulties are by no means insuperable, nor do they entail any great complexity of apparatus or design. The question is one that is certainly worthy of the attention of all interested in the advance of the electric arts, and especially of those railroad managers who are following the natural tendency of progress in this country and amalgamating together various short lines of trolley road into long systems."

The Paris Exhibition.—A meeting of the Exhibitions Committee of the London Chamber of Commerce was held on Tuesday, Sir Albert K. Rollit, M.P., presiding. It was decided (says the *Times*) that the chairman should be requested to prepare a general report on the subject of the Paris Exhibition and the action of the Royal Commission with reference to the British section and other matters affecting British exhibitors. With a view to ascertaining the relative positions of the various countries participating in the Exhibition and of obtaining information for the various trade sections of the Chamber, it was also agreed to request a number of representative gentlemen to prepare special reports on the various departments of the Exhibition with which they were specially competent to deal, including education and instruction, works of art, appliances and general processes relating to literature, science and art, mechanical engineering, electricity, civil engineering, agriculture, horticulture and arboriculture, forests, food products, mining, metals, decoration and furniture, textiles and clothing, chemical and various other industries.

Obituary.—It is with much regret that we have to announce the death of one of Messrs. P. R. Jackson & Co.'s pupils at the front, viz., Mr. David Rew, B.A., Student Inst.C.E., who fell whilst fighting with the Imperial Yeomanry at Lindley. Mr. Rew, who was 23 years of age, was a young engineer of great promise, and may be remembered for the brisk contest which he carried on in our columns some months ago. Unfortunately, Mr. Rew was an only son, and we have no doubt the sympathies of our readers will be extended to his mother and sisters in their sad bereavement.

The death is also reported of Mr. Clement Clarkson, electrical engineer, of Sunderland and Newcastle, at Dewetsdorp, South Africa. Mr. Clarkson was a member of the Imperial Yeomanry, which he joined when it was first formed.

Marriage.—A marriage has been arranged, and will take place in October, between Robert Percy Sellon, son of the late Col. Robert Sellon Sellon, Royal Engineers, and Gwenyth, eldest daughter of the Rev. Canon Dundas, rector of Albury, Surrey.

Long-Distance Telephony.—With reference to Mr. H. T. Wade's letter in our "Correspondence" columns (page 174, August 3rd) we cannot refer the writer to any existing long cable telephone line, as at present none, as far as we are aware, actually exists. We are, however, in a position to be able to give him the following information, of which we have personal knowledge. Experiments made on actual submarine cable (this cable being laid and not simply coiled up in a tank). (1) Length of cable 63 knots, K R 7,900, speaking good, volume of sound ample; (2) length of cable 84 knots, K R 13,900, conversation easy but on the commercial limit. These experiments, it should be stated, were made with ordinary good telephonic apparatus, *i.e.*, not with a specially powerful form, and were made under actual conditions such as would occur in practice. The K R law cannot be rigidly accepted as being correct in its simplest form, as there seems little doubt that the relative value of K and R has an important bearing upon the limit of telephonic speech, *i.e.*, that a greater K R can be spoken through when K is small compared with R, thus, although a K R of 13,900, made up wholly of submarine cable, is on the limit of good speaking, yet a K R of 17,000, made up partly of cable and partly of landline, has given good commercial speech. With reference to the artificial cable, we were misled by Mr. Wade's description of the same, as he states in his paper, "each being equivalent to one mile of cable, with a resistance of 9 ohms and a capacity of ·074 microfarad." This would be usually understood in the sense we had taken it. Dividing, however, 125 by 2, we still have 62·5, which is much beyond Mr. Wade's limit of 27. Experience with both laboratory and actual experiment, with reference to telephonic speaking, has proved that in many cases the former is very misleading unless taken in conjunction with the latter, and unless very great care has been taken in the design of the artificial cable.

Information Wanted!—To some men's ways of thinking there is no limit to the duties of the latter-day editor. He must know something about everything, and be prepared to divulge everything he may know without fee or favour, for the mere asking. Electrical editors are no exception. We have ourselves been asked, in our editorial capacity, to recommend a suitable scheme for the lighting of a certain town; to write giving general information regarding the electric light; to advise consulting engineers whether they should do so and so under such and such circumstances. Now such things as these are bad enough, though perhaps not altogether outside the bounds of reason, but we have never before been asked to say how much a clean board costs. Such a request has come to us accompanied by a string of other questions. We ought perhaps to refer the inquirer to some lady accustomed to apartment letting, to the Hôtel Cecil, or even to the *Timber Trades Journal*. We print the letter, with apologies to the writer (whose name we suppress).

To Alabaster, Gatehouse & Co., London.

Sir,—I wish to get apprenticed to an electrical factor and contractor. I am 24 years of age. I ask you to kindly give me any information: first, about a good reliable house (both a manufacturer and contractor); second, about fee to be paid, and the best way to pay, in instalments or? third, the number of years to serve, and what is the best term, two years or more? fourth, what is the best branch of the profession. Kindly tell me also what it costs for board per month, ordinary clean board in an English town. Please answer me as soon as possible, and oblige

Yours sincerely,

Reply to ———

Modification of Tenders.—*Apropos* of the Bradford Corporation contract matter, to which reference is made in our other columns this week, it is of interest to note the finding of the War Office Contracts Committee which has just been sitting in London. The *Westminster Gazette* says:—"So far as the majority of the Committee are concerned, the Kynoch affair ends with the recommendation that 'in any case in which it might be thought desirable to allow a tender to be modified, a like opportunity should be afforded to all the firms tendering.' It is astonishing that such a recommendation should have to be made."

Electricity for Indian Mines.—According to the *Financial Times*, the announcement made by Lord Ribblesdale at the meeting of the Road Block Company on Thursday last week to the effect that an arrangement has been made with the Mysore Government for the transmission of electrical power for the Cauvery Falls to the Kolar Field was one calculated to interest in no small degree those concerned in the progress of the Indian gold industry, and more especially those who have money invested in the shares of the mining companies. Beyond expressing the thought that the scheme would tend very much to decrease the working expenses all over the Kolar Field, and opining that it would probably take two years to complete, Lord Ribblesdale made no further mention of the project, but we learn that the idea is to harness the falls of the Kaveri, or Cauvery, a great river of Southern India, which flows with a generally south-eastern direction across the plateau of Mysore, for the generation of electricity, which will be conveyed to the mines, about 100 miles distant. The terms of the proposed arrangement to be entered into with the Government, which, it is worthy of note, sent a representative to America and elsewhere to study similar projects, have not been made public, but we understand that the cost of the installation at the falls, as well as of such machinery as will be required at the various properties to enable them to adopt the new motive power, is to be borne by the Government, which will be gradually repaid by the addition of a certain sum to the amount charged for the power supplied. At first some 4,000 H.P. is expected to be needed, and even with this limited amount a great saving is expected to be realised by the companies, in that the cost per horse-power will be much less than under the present system.

Presentation.—On Monday, 6th inst., a number of his late co-workers and friends assembled at the Ferranti Social Club to present to Mr. Wm. Muir, who has been foreman over the winding and transformer departments for over three years at the above works, with a silk umbrella, gold mounted, and ivory handle, on the occasion of his going to fulfil an important post in the works of Messrs. Johnson & Phillips, Old Charlton, London. A similar present was also made to Mrs. Muir.

Personal.—At the last meeting of the Salford Corporation an advance in salary from £160 to £250 for Mr. F. W. Wilkinson, electrical engineer *pro tem.*, was agreed upon.

It has been decided to invite Mr. Alderman Lloyd Higginbottom, chairman of the Electricity Committee of the Manchester Corporation, to accept the office of Mayor for the ensuing 12 months.

Mr. S. H. Short, Technical Director of the English Electric Manufacturing Company, Limited, has been appointed by the Commissioner-General of the Paris Exposition an official delegate of the United States to the International Congress of Electricians which meets at Paris on the 18th of this month. Mr. Short served on the International Congress of Electricians at Chicago in 1893 as member of the Advisory Board, and was also a member of the International Congress held at Philadelphia in 1884.

The Building Trades' Gift to the Nation.—We have received from Mr. McMillan, Hon. Sec. to the Committee of the Electrical Section, a copy of the specifications issued by the Committee for part of the electrical installation required for the Home of Rest for Discharged Soldiers. Intending donors are requested to name a sum which they would be willing to contribute in cash as an alternative, in order to provide for the cost of labour. The plant will consist of two boilers, with pumps, tank, feed-water heater and piping; two compound engines of 50-I.H.P., coupled either direct or by belt to 30-KW. dynamos, with boosters of 6½ KW. coupled to the armature shafts; 1-ton traveller; switchboard; 60-cell storage battery of 900 ampere-hour capacity; mains, wiring, switches, lamps, &c., and a few motors. We trust that the appeal of the Committee will meet with that hearty response of which its object is worthy.

Bolton Electric Tramways.—The income from the Corporation electric tramways for the last quarter was £16,596 7s. 4d., which, after allowing the usual payments for working expenses, leaves a profit of £4,791 4s. The number of car-miles travelled were 304,574, and the units consumed 330,220. The number of passengers carried during the three months was 3,979,055; the total income per car-mile was 12·36d., and the total cost per car-mile 9·14d.

Bolton Vacancy.—The applications for the position of electrical engineer to the Bolton Corporation in succession to Mr. Arthur Ellis, M.I.E.E., who goes to Cardiff at the end of this month, numbered 44, but these have now been reduced to 12. Before interviews are arranged, there will be a further reduction in the number.

Appointment Vacant.—The Watford Council want an assistant engineer for the electricity undertaking at £100 per annum. See "Official Notices" to-day.

Taunton Electricity Works.—On Wednesday next, August 15th, the Mayoress will set in motion the new machinery at the Corporation electricity works.

Deaths by Lightning in America.—Statistics of death by lightning in the United States in 1899, collected by the Weather Bureau, show a total of 536. A negligible quantity?

SUPPLY STATION ACCOUNTS.

Bury Corporation Electricity Accounts.

THE stage has been reached when the Bury Corporation electricity undertaking accounts show a surplus instead of a deficit, and this has been attained on an output of little over 200,000 units. The capital expenditure is increased by almost exactly the same sum as in 1897-98, while the load is exactly the same amount above 1898 as that year was over the preceding one; but the units are increasing more rapidly, owing to the extended use of arc lamps for street lighting, (31 arcs are now in operation)," and partly to the maximum demand tariff which encourages the long-hour consumer." As a result, the load factor, which was 9 per cent. in 1898, is now 12½ per cent.

GENERAL STATEMENT.

	1898.	1899.	Increase.
Total capital expenditure ...	£33,079	£40,715	£7,636
Number of units sold	115,853	213,395	97,542
Maximum load in KW.	144	197	53
Gross revenue	£2,183	£3,645	£1,462
Gross profit	£1,071	£1,986	£915
Average price per unit sold ...	4·35d.	3·95d.	– ·40d.

The satisfactory growth of the business is shown by the figures below:—

Year.	Consumers.	Lamps connected.	Units private lighting.	Power.	Public lighting.	Maximum load. K.W.	Load factor.
1896	41	2,481	—	—	—	—	—
1897	84	6,155	59,804	160	4,498	91	8%
1898	144	10,275	103,019	3,941	8,885	144	9%
1899	198	14,733	159,562	8,828	45,505	197	12½%

The revenue from all sources has fallen by ·42d., but the total costs have done more even than this for they show a reduction of ·44d. per unit. Mr. S. J. Watson, who has every reason to be satisfied with the accounts, recommends that no alteration in price be made until January, 1901, a safe and proper course to adopt if it be desired to maintain a surplus.

Revenue Statement.

	1898. Gross.	1898. Per unit.	1899. Gross.	1899. Per unit.	Increase.
Sale of energy	£2,102	4·35d.	**£3,507**	3·95d.	—·40d.
Meter rents, &c.	81	·17d.	**118**	·13d.	—·04d.
Supply of lamps, &c.	...	...	**20**	·02d.	+·02d.
Sundry fees	...	...	...	...	...
Gross revenue ...	£2,183	4·52d.	**£3,645**	4·10d.	—·42d.

An additional expenditure of £135 has been necessary on account of the advance in the price of fuel, the average price paid during the 12 months being 9s. 6½d. per ton as compared with 6s. 11d. per ton in 1898. Although the price of fuel per ton gives an advance of 38 per cent., there is only an increase of 18½ per cent. in the item per unit sold, a result attained by greater economy in the running of the works, due to the larger output and better load factor. We regret to note that at Bury the distributing cables have been the cause of some anxiety owing to the breakdown of the vulcanized india-rubber. In the "costs" the fall in wages balances the rise in coal, and the "works' cost" remain practically unaltered. The improvement in the "total costs" is attributable to the reduction per unit on rent, management and establishment charges. How Mr. Watson managed to reduce his total charges against rent, rates and taxes is not explained, and is of interest, being most unusual.

Cost of Production.

	1898. Gross.	1898. Per unit.	1899. Gross.	1899. Per unit.	Increase.
Coal	£225	·47d.	£489	**·55d.**	+·08d.
Oil, waste, water and engine room stores and carbons	51	·10d.	98	**·11d.**	+·01d.
Salaries and wages incurred in generation and distribution and attending public lamps.	243	·50d.	377	**·42d.**	—·08d.
Repairs and maintenance of buildings, engines, boilers, dynamos, &c.	48	·10d.	88	**·10d.**	·00d.
Works costs ...	£567	1·17d.	£1,052	**1·18d.**	+·01d.
Rent, rates and taxes ..	209	·43d.	179	**·20d.**	—·23d.
Management expenses, salaries of managing engineer, secretary, clerks, &c.	279	·58d.	353	**·40d.**	—·18d.
General establishment charges, stationery and printing, law charges and insurance.	57	·12d.	74	**·08d.**	—·04d.
Other expenses	...	...	1	...	...
Total costs ...	£1,112	2·30d.	£1,659	**1·86d.**	—·44d.

The increase in gross profit by £900 has provided the £400 to cover the additional charges for interest and sinking fund and £500 by which the loss of over £300 has been turned into a surplus of nearly £200. The results, both technically and commercially, are therefore very good indeed.

Profit Statement.

	1898.	1899.
Interest on loans	£776	£995
Sinking fund for repayments	631	808
Net profit carried to credit of general rate	—336	183
Gross profit	£1,071	£1,986

Wolverhampton Corporation Electricity Accounts.

The report for the first of the two years dealt with below gives an opinion which explains the appearance of an extraordinary item in the accounts of the Wolverhampton municipal electricity undertaking for last year. The Electric Lighting Committee state that, in their opinion, the breaksdown of supply in 1898 were attributable to a certain risk of accident inseparable from the high tension continuous current system, but that the conversion to the three-wire system, an expenditure for which had been sanctioned by the Town Council, would enormously reduce the possibility of further breaksdown. The year 1899 was one of exceptional difficulty, as the alteration in the system of supply necessitated two systems being in operation for the latter six months, involving considerable additional expenditure out of revenue on account of working costs, more especially in the consumption and cost of fuel.

General Statement.

	1898.	1899.	Increase.
Total capital expenditure ...	£49,834	**£74,066**	£24,232
Number of units sold	371,830	**482,277**	110,447
Maximum load in 32 watt lamps	19,932	**25,184**	5,252
Gross revenue	£7,746	**£9,476**	£1,730
Gross profit	£3,637	**£3,382**	—£255
Average price per unit sold ...	4·90d.	**4·61d.**	—·29d.

The gross profit has fallen, notwithstanding a large increase in revenue, but this has been caused by the appearance of an extraordinary item in the costs sheet of over £900, which represents the re-wiring of armatures and the altering of fittings, changing lamps, &c., of 121 consumers to suit the increased pressure of supply.

The revenue account is very satisfactory from the fact that the use of electrical energy for power purposes is increasing. Private consumers of the better class are also being connected in increasing numbers. The growth of the department's business is shown by the following figures:—

Year.	No. of consumers.	Increase per cent.	No of lamps connected.	Increase per cent.	No. of units sold.	Increase per cent.	Financial result. Loss.	Financial result. Profit.
1895	113	..	8,941	..	191,701	..	£1,403	..
1896	154	36	11,307	26	224,709	17·2	..	£326
1897	208	35	14,151	25·2	291,223	29·5	..	590
1898	276	32·7	19,932	40·8	371,830	27·5	..	1,005
1899	364	31	25,184	26·3	482,247	29·7	..	403

From May, 1898, the rates charged were:—Power, 2d. per unit for first two hours daily and 1d. after; for lighting, 6d. per unit for two hours daily from September 30th to March 31st, and one hour daily from April 1st to September 29th, and 3d. per unit for all after the above two hours and one hour daily use respectively.

Revenue Statement.

	1898. Gross.	1898. Per unit.	1899. Gross.	1899. Per unit.	Increase.
Sale of energy	£7,599	4·90d.	**£9,260**	4·61d.	— ·29d.
Meter rents, &c.	139	·09d.	**178**	·09d	— ·00d.
Supply of fittings and work done for consumers	8	·01d.	**38**	·02d.	+ ·01d.
Sundry fees, &c.	...	...	...	...	...
Gross revenue ...	£7,746	5·00d.	**£9,476**	4·72d.	— ·28d.

The general character of the costs sheet has already been referred to, but Mr. Shawfield may be considered to have done very well with a rise of only ·38d. in total costs, when "coal" is up ·33d., and the total of "repairs" ·43d. The figures for the current year should show excellent progress.

Cost of Production.

	1898. Gross.	1898. Per unit.	1899. Gross.	1899. Per unit	Increase.
Coal	£950	·61d.	£1,888	**·94d.**	+·33d.
Oil, waste, water and engine room stores.	336	·22d.	364	**·18d.**	—·04d.
Salaries and wages incurred in generation and distribution and attendance, repairs, &c., of public lamps	1,216	·79d	1,394	**·69d.**	—·10d.
Repairs and maintenance of buildings, engines, boilers, dynamos, &c.	300	·19d.	327 912*	**·16d.** **·46d.**	—·03d. +·46d.
Works costs	£2,802	1·81d.	£4,885	**2·43d.**	+·62d.
Rent, rates and taxes ..	133	·09d.	183	**·09d.**	—·00d.
Management expenses, salaries of managing engineer, secretary, clerks, &c,	764	·49d.	712	**·35d.**	—·14d.
General establishment charges, stationery and printing, law charges and insurance	410	·26d.	314	**·16d.**	—·10d.
Other expenses	...	...	...	...	...
Total costs ...	£4,109	2·65d.	£6,094	**3·03d.**	+·38d.

* Changing over system of distribution of electricity.

The amount in hand on account of the working of previous years was £416. The profit made in 1899 was added to this and the sum set aside to form a reserve fund.

Profit Statement.

	1898.	1899.
Interest on loans	£1,320	£1,655
Sinking fund for repayments	1,312	1,324
Net profit carried to reserve fund	...	403
" " forward	1,005	...
Gross profit	£3,637	£3,382

CITY NOTES.

Castner-Kellner Alkali Company, Limited.

An extraordinary general meeting of this company was held on Wednesday at Cannon Street Hotel, when certain resolutions were passed for effecting the purchase of the undertaking and assets of the Aluminium Company, Limited, and for the purpose of carrying the necessary agreement into effect authorising the borrowing, in addition to the £150,000 already authorised, of additional sums not

exceeding in the whole £120,000, making the total amount which the board may borrow £270,000; also increasing the capital of the company from £300,000 in £1 shares to £450,000 in £1 shares; and authorising the board to allot 130,000 of such shares as fully paid up towards payment for the properties to be acquired from the Aluminium Company, and to dispose of the remainder as they think fit. These resolutions, as well as those connected with the directors and their remuneration, were all passed unanimously.

Mr. W. Mather, M.P., who presided, explained the proposals to the meeting at some length. He stated that since the completion of the Castner-Kellner works, and the successful prosecution of the industry they had established, the directors had from time to time considered the importance, for the future development of their undertaking, of adding to it other branches of commercial manufacture, and they had endeavoured to discover what might profitably be joined up to the manufacture of the caustic soda and bleaching powder, which were their present products, such other chemical manufactures by the electrolytic process which would enlarge the scope of their operations, and add to them one which had been already successfully established. In the course of those considerations it had happily come before them, without their seeking specially for it, to consider the question of joining with the Aluminium Company, of Oldbury, near Birmingham, since that company's requirements for the future needed considerable addition to their business to render it necessary for them to obtain cheap steam and electrical power, and enlarge very much their products. The directors of the Castner-Kellner Company looked at the position of the Aluminium Company with great interest, and providing satisfactory arrangements could be made, it was evident that it would be a desirable thing if the two companies could be joined together in one large electrolytic company. Under such conditions they foresaw that not only the products which they were now producing could be continued with better results, but also that they must prepare for still further extensions in the future arising out of the benefits and success that such a combination would probably bring about. The opportunity had been seized upon very cordially by the directors. There was a natural bond between the two companies; the Aluminium Company were the vendors to the Castner-Kellner Company of the patents under which the company was carrying on its operations. The connection was intimate in consequence of the considerable quantity of product which the Aluminium Company had always taken from this company. Their caustic soda was proved to be admirably adapted—owing to its purity—for the chief manufacture of the Aluminium Company, and they had been large customers. The chairman then proceeded to explain the capital, &c., and position of the Aluminium Company, which, together with the consideration to be paid, is briefly set out in the circular which we print below. The directors anticipated that when the new works for the manufacture of sodium were established at Weston Point and they are using the Castner-Kellner company's power plant there would be a very large saving made in the manufacture of sodium, and the additional saving of being able to put the sodium required by the Aluminium Company by means of a pipe from the works into their department, and so a saving would be made on the packing and carriage and incidental loss of transporting the caustic soda. A portion of the shares held by the Aluminium Company were in companies working patents of theirs in Germany and Niagara Falls for the manufacture of sodium. The German company had only just started, but had good prospects. The Niagara Chemical Company were paying very large dividends. There were also shares in Matthiessen's Alkali Works of America. If the resolutions were passed, they would have to be submitted to another meeting as special resolutions, but before the amalgamation could be effected the consent of the debenture holders in the Castner-Kellner Company must be obtained, and a meeting for that purpose was to be held that afternoon. Shareholders of the Aluminium Company as well as the debenture holders had agreed to the scheme. They now awaited the resolutions of the Castner-Kellner Company. One of the company's patents—the Kellner patent—had been the subject of litigation for some time past. It was promoted by this company to oppose what they alleged to be an infringement by a company recently brought into existence. After having passed through the vicissitudes of the several Courts, the House of Lords on their appeal from the Lower Court gave judgment against them on a legal technical point, viz., disconformity between the provisional and the complete specification. Whether they would amend the specification or not they had not decided. It was clear that they were amply justified in bringing the action for infringement, because he thought infringement would have been clearly allowed if the patent had not been unsound on the ground of disconformity. The other allegations and claims made by this company had not been decided or tried because the patent was considered to be unsound. The Kellner patent was not being worked by them. They had several patents connected with their industry. They acquired the Kellner patent for the purpose of covering as much ground as possible, and protecting the Castner patent. The result of the litigation made no difference to the company's position, and they would continue to manufacture as heretofore under the impregnable situation of having the patents they relied upon absolutely sufficiently strong to maintain under any circumstances. In addition to the patents they had, during their development of this enterprise, discovered for themselves so many things more valuable than patents, that personally it did not concern him if their patents were attacked or not, although they were compelled to take up the defence, so that it should not be assumed that their patents were open to doubt. They were very much strengthened in their patent rights by the fact that the Rhodin and the Kellner patents were the subject of litigation in Germany, where the patent law was infinitely superior to the English law. There a law suit was brought by the Kellner patent owners against the owners of the Rhodin for infringement, and the judgment had been pronounced entirely in favour of the Kellner patent, the Rhodin being declared an infringement. There the plain issue of infringement was tried, not disconformity.

The agreement for the purchase was read in abstract by the solicitor (Mr. Hawes).

The circular issued to the shareholders reads as follows:—

You will find overleaf a notice of an extraordinary general meeting of the members of this company, to be held on August 8th next, called to consider a provisional agreement, which has been entered into by your directors, for the amalgamation of this company with the Aluminium Company, Limited, which is proposed to be carried out by the purchase by this company of the undertaking and assets of the Aluminium Company, other than the shares held by them in this company. According to the balance-sheet of the Aluminium Company, made up to March 31st last, copy of which is sent herewith, the assets of that company stood at £309,683, but from this must be deducted £66,000 the par value of 66,000 shares of this company (at which price they are taken in the balance-sheet) not included in the purchase, making the amount £243,683. The consideration to be paid to the Aluminium Company is to be satisfied by the allotment of 130,000 shares of £1 each, fully-paid, to this company, and this company is to take over their debenture debt by allotting to their stockholders £90,000 of debenture stock, to rank *pari passu* with the £150,000 of the existing stock of this company. This company is to pay the liabilities of the Aluminium Company, but will be entitled to the profit made by them from March 31st last. Your directors are of opinion that these profits may be considerably increased by the removal of the works now at Oldbury to this company's works at Weston Point, where sodium can be produced at a lower cost, owing to electric power being cheaper, and to caustic soda, which is so largely used in the process, being manufactured on the spot. The consent of the debenture stockholders of this company, authorising the issue of the further sum of £100,000 to rank *pari passu* with the existing debenture stock of £150,000, will have to be obtained. A meeting of the debenture holders will be held, when the necessary resolution will be submitted for their consideration. Your directors feel it right to say that they recommend the purchase.

Central London Railway Company.

The directors' report for the half-year ended June 30th, 1900, reads as follows:—

"The expenditure for the half-year amounted to £185,712 6s. 4d., the total to June 30th, 1900, being £3,353,596 13s. 4d. The directors hoped to be able to open the railway for traffic in the early part of July, but their expectations were not fully realised, some modifications in the plant being found necessary during the experimental working, as explained in the engineer's report. The approval of the Board of Trade having been given, the railway was opened for traffic on Monday, July 30th. In anticipation of the opening, H.R.H. the Prince of Wales, at the request of the directors, kindly inaugurated the undertaking by accompanying them, and other gentlemen connected with the company, in the first train that carried passengers over the whole length of the line. His Royal Highness was much interested, and cordially wished success to the new enterprise. As a commencement, a week-day service of trains will be run from about 5.0 a.m. to 12.0 p.m. at intervals of five minutes, but more frequent trains will be provided, especially during the busiest hours of the day, as soon as practicable. A reduced service will be run on Sundays. Provision has also been made for the conveyance of workmen in accordance with the Company's Acts of Parliament."

Engineers' Report.

Gentlemen,—On March 1st the first experimental train was run between Shepherd's Bush and Queen's Road, with the sub-station at Notting Hill Gate in operation.

Three months later trains commenced running between Shepherd's Bush and the Bank, with the sub-stations at Notting Hill Gate, Marble Arch, and Post Office in operation.

The results in all instances were satisfactory.

The electric lifts have passed all tests without difficulty.

The generating plant at the depôt and the electric locomotives and carriages have fulfilled our expectations.

Although every effort has been made to complete the line at the earliest possible date, our anticipations have been somewhat disappointed, owing partly to labour difficulties and partly to the introduction of minor improvements suggested by practical experience in the experimental working of the plant.

We are, gentlemen, yours faithfully,

Fowler & Baker.

The tenth half-yearly meeting of the shareholders of this railway was held on Wednesday at the Holborn Restaurant, Sir Henry Oakley (the chairman) presiding.

Before moving the adoption of the report, the Chairman said that the proprietors now numbered 2,008, which was an increase of 97 since the last meeting. Continuing, he said that the board would desire to congratulate the shareholders most heartily on the successful completion and opening of the undertaking. On July 30th they were able to commence running trains, and from the hour of its commencement down to the present time there was every indication that the most sanguine estimates as to its utility and popularity with the public would be realised. He must do their engineers and contractors the justice to say that they had worked hard and loyally to ensure the line being opened as quickly as possible. They would see by the accounts that in the half-year they had only spent about £185,000—very much less than they had ordinarily spent in the same period. That was really due to the fact that the body of the works had been completed, and that the lighter works of the stations, the electric lighting gear, &c., though occupying time, had not absorbed so much money. They would, perhaps, like to know how they stood for capital expenditure, and on that point, without committing themselves to a final statement, but having carefully revised all their estimates of work yet to be done and paid for, they had every reason for the faith that was in them when he said that they believed the whole undertaking would be completed for the

original capital, and that unless their business so expanded as to render a further large expenditure necessary, they would not, at all events at present, require any authority to raise further money. It was due to his predecessor in the chair, and to the board, to state that the results of their examinations of their contracts made four or five years ago showed that they had the prescience to foresee what the probable expenditure would be. They were aided by close estimates from their engineer, and their care in that respect was rewarded that day when they found themselves in the position — most unusual with any new undertaking — especially with an undertaking like theirs, replete with hidden dangers, and difficulties due to underground works—of finding their estimates sufficient. Notwithstanding those difficulties and dangers the estimate the board made had been well maintained, and would not result in disappointment. There was a large sum due to the contractors, for the arrangements made by the board had this great merit, that the contractors were to be paid a proportion of their expenses by debentures, but those debentures were not to bear interest until the line had been completed, and opened for traffic. It was hardly possible to conceive a greater inducement to a contractor to push on with the work, seeing that until it was completed, he was deprived of the interest on the sum of £500,000. The shareholders would be pleased to know that the Board of Trade gave their approval to the opening of the line in the following terms:—"The work throughout appears to be of a very substantial nature, and no money or effort has been spared to render the railway as complete as possible in every detail." Although only opened for traffic on July 30th, they had been working more or less diligently during the half-year. Practically step by step and yard by yard as the railway was completed they obtained possession of it for the purpose of testing in a practical way the road, line, stations, lighting the carriages, &c., and they took that opportunity of training the staff, because the work was somewhat unusual even for railway men; happily, under the admirable management of their general manager, Mr. Cuningham, they were enabled on the day of opening to do so with a complete and efficient staff, who had carried on the work since in a most highly satisfactory way. He would like to refer to the obligation the board were under to H.R.H. the Prince of Wales who kindly inaugurated the undertaking. For some time H.R.H. had taken a deep interest in their enterprise, and when the time approached for its completion he most cordially and kindly expressed the wish to go over it. He did so, accompanied by the board and a few friends. He examined all the details—the power house, electrical department, &c., and at the end expressed in the most cordial and warm-hearted manner his hearty wishes for the success of their enterprise. The board were especially pleased to see H.R.H., and he was sure the shareholders would join with them in expressing their appreciation of the kindness shown by his visit. Having completed the railway, they set to work, and beginning at 5 o'clock on Monday morning, July 30th, they started with a series of trains five minutes apart. They established a general 2d. fare for any distance, and they waited with some anxiety to see how far the public would appreciate the railway itself and the mode in which they proposed to conduct it. He was pleased to say that from the moment of its opening it had shown one continued success. The first morning the trains to the City were crowded, and they had been crowded ever since, with the additional advantage to them that the mid-day trains also filled fairly satisfactorily. The first day they carried 85,400 people, the second 91,900, the third, which was wet, 86,700, the fourth 96,100, the fifth 80,700, and on the Saturday 102,793. On Sunday the passengers numbered 64,742, on Monday 100,391, and yesterday (Tuesday) they carried no fewer than 105,171. That showed that the public very much appreciated the services they had rendered them, and he thought it proved that the traffic was a real traffic, and not made up by people who travelled from curiosity. There had been sundry complaints of over-crowding already, and no doubt between four and six o'clock the trains starting from the City were overcrowded. The board sympathised with those complaints, and they did not intend to rest until they had removed the difficulty as far as was humanly possible. At present their trains ran at five minutes' intervals. In two or three days they would run every four minutes, and as fast as they could get complete trains ready and electrically fitted, they would come down to 3½ or 3 minutes, so that as far as possible they hoped to be able to remove all complaints on the ground of overcrowding. With so small an experience, of course they were not yet in a position to make any estimate as to the future, and naturally the expenses of working at the opening would bear a greater ratio to the receipts than they would when everything had settled down. He might, however, say for himself and his colleagues, that they were quite satisfied with the progress they had so far made. They had realised their expectations, and, in fact, gone somewhat beyond them. They saw their way to improve the service and making their railway still more popular, and they all hoped that when they succeeded in doing that, they would not only satisfy the public, but have a broad base upon which to build their future prosperity, with the result that that prosperity might come in a tangible form to the shareholders.

Lord Rathmore seconded the motion.

Replying to questions, the Chairman said the directors recognised that they were trying an experiment in charging a 2d. fare the whole distance, but having made most careful inquiries, both here and in America, they were satisfied, and they were adopting the right method of charging. He would not presume to say that they would not alter their practice, because they had yet to gain further experience, and if they saw any sound reason to charging intermediate fares, they would not hesitate to do so. They had decided not to issue season tickets, but instead, to sell books of 24 tickets.

The report was then adopted.

Waterloo and City Railway.

The report of the directors of this company for the half-year ended June 30th, submitted to the meeting held in London yesterday, states that the capital account shows a total outlay of £589,073 on June 30th. The further estimated expenditure of £25,000 is provided for by the capital powers of the company. The gross receipts of the line, less Government duty, amounted to £14,133. From this amount the London & South-Western Company have retained £5,398 in respect of working expenses, leaving £8,735 payable by them, in order to provide, under agreement, for a dividend at the rate of 3 per cent. per annum, payable 11th inst., on the company's ordinary and borrowed capital. The number of passengers carried during the past six months, exclusive of season ticket holders, was 1,868,737, an increase of 152,912. The season ticket holders on June 30th last numbered 911, as against 747.

Great Northern and City Railway Company.

The report of the directors for the half-year to 30th ult., submitted to the meeting to be held in London on 3rd. prox., states that satisfactory progress has been made with the driving of the tunnels during the past half-year, and the speed of construction will soon be greatly accelerated by the erection of four additional shields, two of which will drive southward from Drayton Park, and two southward from Old Street. At Regent's Canal the up and down line tunnels have been driven for distances which, together, amount to more than 1 mile of single tunnel. It is expected that the site for the station at Old Street will be obtained and work begun there very shortly. At Essex Road the station tunnel for the down line has been driven to its full length, and that for the up line about half its length. The concreting of the tunnel front has been completed at Drayton Park.

British Electric Transformer Manufacturing Company, Limited.

The second annual meeting of the above company was held last Friday at Faraday House, Charing Cross Road, and in moving the adoption of the report, the Chairman said the business done during the year had been quite up to expectations, the turnover had been £24,043 8s. 10d., as compared with £12,614 16s. 6d. in the previous year, so that they had, therefore, nearly doubled their output. The total revenue was £24,404 4s. 10d., as compared with £12,835 10s. 3d. On the debit side of the profit and loss account, their manufacturing charges were £13,448 11s. 4d., being equal to about 5 per cent. of the turnover as compared with £10,230 1s. 9d., or equal to about 81 per cent. of the turnover for the previous year. The general charges were £2,433 9s. 9d., compared with £1,242 2s. 10d., the percentage in both years being about 10 per cent. of the turnover. They had written off £714 3s. 8d. for depreciation as compared with £365 3s. 8d. After deducting all charges, there was a profit of £6,184 8s. 9d., compared with £998 2s. 9d., which they would agree was a satisfactory result. The first and principal asset in the balance-sheet was £25,356 6s. 5d. for patents. Since they last met they had succeeded in obtaining letters patent for their transformers in Germany, one of the most valuable of the foreign patents, and their transformers were now covered by letters patent in Germany, France, Belgium, Italy, Austria, Switzerland, United States, New South Wales, South Australia, West Australia, Queensland, and Tasmania. The question of how the foreign patents were to be dealt with was receiving the careful attention of the board. They had recently been approached with reference to the sale of the French patent, but they had not been in a hurry to sell that or any patent. The favourable result of the year's trading would, they believed, enable them to do something definite in this direction either by way of sale or by manufacturing the transformers in some of the countries in which they were covered. Their transformers were being exhibited at the Paris Exhibition, which entitled them to add an additional six months to the time within which they must work the patent in France. The average time which each of the patents had still to run was 11 years, and although their value should not be depreciated in the balance-sheet, still they considered that it would be prudent to set aside the sum of £2,500 out of their profits as the nucleus of a reserve fund for the purpose of gradually writing this asset down. Plant and machinery was £2,473 12s. 9d., the additions during the year amounting to £374 16s. 2d., and £493 13s. 5d. having been written off the depreciation. The stock as per manager's valuation was £3,482 8s. 4d., and the work in progress amounted to £1,165 0s. 5d. They had orders in hand to the amount of £6,769. The capital was £40,000, of which £20,000 was in vendors' shares. Under the terms of the agreement with the vendor his shares did not rank for dividend until the subscribed shares had received 10 per cent. for one complete year. As they proposed at the meeting to recommend a dividend of 10 per cent., these vendors' shares would rank *pari passu* with the subscribed shares as for July 1st, and considering the very excellent results they had achieved, he did not think that anyone would grudge Mr. Berry participating in their success. It would mean in the future that they would have to double the capital upon which to pay dividends, but they had taken that into account, and carried forward a very substantial amount to next year. They would have seen that the leases of their present works expired next year, and as the buildings were coming down, the lease could not be renewed. After careful

consideration they had come to the conclusion that it would be more economical to purchase a plot of freehold land, and erect their own works. The negotiations for the purchase of the land were now nearly completed, and they expected to be able to pay for that and erect and equip their works without increasing their present capital. That estimate might be a little sanguine, but at any rate they meant to try, and if they could not they ought to have no difficulty in creating a temporary loan at a low rate of interest on the security of the freehold land and works. In conclusion, he moved a dividend at the rate of 10 per cent. per annum, together with a bonus of 2½ per cent. for the half-year ending June 30th.

Mr. T. Petersen seconded the motion, which was agreed to.

Marconi International Marine Communication Company.

The statutory meeting of this company was held on 1st inst., Major S. Flood Page presiding.

The Chairman said that the business of the company was practically limited to ship to ship and shore to shore. A commencement with this work had been made in Belgium. A site had been determined upon for the erection of the first Marconi mast in Belgium, and a Belgian steamer was about to be fitted, and before very long they hoped by degrees to have the system working on all the Belgian coast. They were also working with a view to get permission for concessions in France and Spain and Newfoundland for the establishment of stations. It was quite impossible with such a system that they could set to work immediately the company was formed, especially as there was a telegraph monopoly all over the world. They claimed that no system of wireless telegraphy could prove successful unless they used Marconi patents in one form or another. The parent company were undertaking to defend the patents at the right time and place. The new company does not carry on experiments, that being left to the Wireless Telegraph Company. He proceeded to refer at some length to the opposition of the Post Office, which claimed a monopoly. They did not want to quarrel with the Post Office, but they had no intention of being bullied. If the company fitted its system on a ship, and that ship went up and down the English coast, it could speak to half a dozen stations without interference by the Post Office. They had got a contract with the English Navy, under which 32 ships or torpedo stations would be fitted up with the Marconi apparatus, but they did not know when work would commence. They had to carry out a difficult test in connection with that contract. A ship was to be fitted at Portsmouth and another at Portland, and communication established between them. It was difficult, but they expected to be able to carry out the contract. They had had the apparatus at Delagoa Bay on four of H.M. ships for several weeks, and satisfaction had been given. The Portuguese Government were carrying out an installation at Lourenco Marques. A committee was sitting to determine various questions with reference to the communication between the land, lighthouses, and lightships, and it was intended to call Mr. Marconi and himself to give evidence. Dividends could not be talked about yet, but they were bound to follow good and successful work.

National Electric Supply Company, Preston.

An extraordinary general meeting of the shareholders of this company was held at the company's offices, Preston, last week, the object being to increase the capital of the company to £184,943 by the creation of 20,000 new £5 shares. Mr. John Booth presided.

The Chairman, in moving the necessary resolution, said the company is now doing very well indeed. Last year was the best year we ever had, and so far this year we show a substantial increase of profit over last year, and this in spite of the greatly advanced price of coal. We are expecting to have a very busy winter, and we hope to have our new engine and boiler house ready in time for it. We are sure that between now and the Preston Guild we shall have a large increase of consumers, and we are asking you to approve of our having a larger capital in order that we may be in a position to accept all the profitable business which may be offered to us. Moreover, we want to extinguish the whole of the debentures, so that the entire property of the company will belong to the shareholders. We are sometimes asked about the proposed electric trams. Well, with our new machinery we shall be in a position to supply electricity for the trams at a lower rate than the Corporation or a separate company could possibly generate it for themselves, and we hope to be able to show to the Corporation that it would be a waste of the ratepayers' money to erect a separate generating station. The resolution was carried unanimously.

The Chili Telephone Company, Limited.

The report of the directors for the year ending March 31st, 1900, to be submitted to the shareholders at the eleventh ordinary general meeting, to be held on 10th inst., at the company's offices, 42, Old Broad Street, E.C., reads as follows:—"The aggregate number of subscribers at all centres at the end of the year was 4,613, as compared with 4,486 at the beginning, or a gain of 127 for the year. The gross revenue in Chili from all sources was—In 1899-1900, $651,436; in 1898-1899, $599,994; an increase of $51,442. The expenditure in Chili was—In 1899-1900, $364,549; in 1898-1899, $375,230; a decrease of $10,681. The net income in Chili from all sources was—In 1899-1900, $286,887; in 1898-1899, $224,764; an increase of $62,123. The average rate of exchange for the year was 15·17d., as compared with 14·27d. in the previous year, giving an increase for the year of 0·90d. Converted into sterling at these rates, the figures given in the preceding paragraph are—In 1899-1900, £18,130; in 1898-1899, £13,366; an increase of £4,764. The liquid assets and liabilities in Chili on March 31st, 1900, were valued at 16½d., the current rate of exchange on that day, as compared with 14½d., at which they were valued on the corresponding date of the previous year. The increase of the value of the liquid assets over liabilities in Chili, due to this rise in exchange, amounts to £1,755, which has been carried to reserve. The balance to the credit of the revenue account, including £448 brought from the previous year, is £12,847, of which £3,044 has been carried to reserve for depreciation and renewals. The directors recommend the payment of a dividend of 4s. per share, free of income-tax, being at the rate of 4 per cent. per annum, absorbing £8,800, and leaving a balance of £1,003 to be carried forward. During the year the capital outlay in sterling was £1,798, and the total mileage was on March 31st, 1900, 8,298 miles 990 yards, an increase of 233 miles 477 yards during the year. Mr. George Keith retires from the board of directors, and being eligible, offers himself for re-election. The auditor, Mr. Thomas A. Welton, also retires, and offers himself for re-election.

The Hong Kong Electric Company, Limited.

The report of the directors to the eleventh ordinary yearly meeting, held at Hong Kong on July 7th, gives a statement of the company's accounts for the year ending April 30th, 1900. The balance at credit of profit and loss account is $51,216.36; after deducting directors' fees, $3,000, there remains the sum of $48,216.36 available for appropriation, and the directors recommended that this be disposed of in the following manner:—

To pay a dividend of 7 per cent. per annum:—	
Say 70 cents per share on 30,000 fully paid shares	$21,000.00
Say 7 cents per share on 25,896 partly paid shares (6 months)	1,812.72
To write off plant account for depreciation	24,354.28
To carry forward to next account	1,049.41
	$48,216.36

The manager's report states that on June 1st the lamps and fans connected to the company's incandescent lighting mains were equivalent to about 10,600 lamps of 8 c.p. The number of arc lamps now in operation is 84, two additional lamps having been erected in H.M. Naval Yard during the year. The power supply service is at present operating seven lifts on the *Reclamation*. During the past year the incandescent lighting plant has been increased by laying down a new engine, alternator, and boiler. These, however, were not delivered in time to operate during the heavier winter loads, and in consequence, the company's available plant was severely taxed on many occasions.

Dublin United Tramways Company.

Mr. W. M. Murphy presided at the meeting of this company on July 31st, and, in moving the adoption of the report, said that the accounts recorded steady, if not sensational, progress. The gross receipts of the United Company were £12,400 more than in the corresponding half-year of 1899, while the total working expenses were actually £4,342 less. The net profits were, therefore, £16,742 better, having been £23,377 last year and £40,118 this year, an increase of over 70 per cent. The net earnings of the Southern District Company's line were practically the same as the corresponding half-year, so that the whole of the increased profit was due to the conversion from horse to electric traction of the city lines. The increased profits had had to meet increased wayleaves, together with increased interest on Bank overdraft and on mortgages, the total under these heads being £10,289 this year against £6,439 last year. They had incurred a loss on the re-sale of horses during last year amounting to £1,562, which they had written off from revenue, and they had also written off £1,000 of the preliminary expenses, leaving a balance of £1,073 on this account. The stud of horses is now reduced to 109. There used to be some 1,500 or 1,600. As they will have to keep a permanent stud of some 70 horses, only about 40 more will have to be disposed of, so that the loss under this head may be said to be almost at an end. After the foregoing appropriations they were able to declare a dividend at the rate of 7 per cent. per annum, being an increase of 2 per cent. on the dividend declared last year. The expenses were increased during the half-year by the reduction of the men's hours of labour and increased wages to some of the men. As to the future, they showed an increase for the last four weeks of more than £2,000, or above £500 per week, and if they had average weather for the rest of the year there was every reason to anticipate steady increases of traffic receipts. They had been adding rolling stock as fast as they could procure it, but had experienced some delay in getting deliveries of cars. At the meeting in February he expressed the opinion that they would have work for 250 cars in August. They had, in fact, work for that number now, and by next summer they would require a further increase in the stock of cars. One of the great advantages of the electric system was the facility with which cars could be run out at short notice and operated when profitable work offers. In the matter of expenditure they had not yet arrived at the most economical basis for the production of electric current. The Ringsend station continued to justify all that was anticipated from it, but owing to the delay in delivery of multiphase generating plant required for working the Southern District line from Blackrock to

Dalkey, they had had to keep the Ballsbridge station open, which would otherwise have been shut down. During the half-year they generated 442,000 units of electric current at Ballsbridge, at a cost of 1·33d. per unit more than the cost of the current at Ringsend, and when all the current for working the Dalkey line is supplied from Ringsend, this will represent a saving of £2,400 in a half-year. The abnormally high price of coal was also telling for the moment against the generation of electricity at the lowest possible cost. There was an item of expenditure which they might have to incur in the future, owing to the decision of the magistrate, confirmed by a majority of the Court of Queen's Bench, for what is known as sanding the streets. The cost under that head when working horse tramways, and carried out for their own convenience, amounted to a little more than £200 or £300 a year, and at the outside they did not estimate it would cost them more than £400 or £500 a year. But they were not at all satisfied that the decision given was a right one, and they would take steps to have the question tested further.

The mileage covered by the cars on the lines of the two companies, that is, of the Southern Districts and the Dublin United, during the half-year was 3,277,000. The passengers carried were 21 millions, and the average fare paid by each passenger on the United Company's system was 1·17d. The proceeds of the 1d. fares were 84 per cent. of the total receipts, while last year they were only 54 per cent., with corresponding reductions in 2d. and 3d. fares. That, of course, had arisen from the general reduction of fares, and the result of this change was that while the increase in 1d. fares was £21,000, the company received £9,000 less from the higher fares, which the public got the benefit of in reduced cost of travelling. Now that the electrical equipment of the tramways was practically completed they might fairly congratulate themselves and the public on the result. Dublin was still far ahead of any other city in the United Kingdom for the extent of its electric tramway system and for the excellence and cheapness of its service.

Liverpool Overhead Railway Company.

The report of the directors to be submitted to the 24th ordinary half-yearly general meeting of the shareholders, to be held at Liverpool, on August 14th, 1900, is as follows:—

The gross revenue receipts to June 30th, 1900, amount to £38,124 1s. 2d., and the working expenses to £25,113 3s. 9d.

The number of passengers carried during the last two years is as follows:—

	Half-year ending Dec. 31st, 1899.	Half-year ending June 30th, 1899.	Half-year ending Dec. 31st, 1899.	Half-year ending June 30th, 1900.
First class	663,177	594,669	676,768	635,449
Second class, including tramways	2,962,827	2,445,573	2,941,392	2,477,025
Workmen (special return tickets)	1,368,917	1,435,038	1,596,797	1,575,388
Total ..	4,894,921	4,475,279	5,214,957	4,687,862

There has been considerable delay in completing the Waterloo and Crosby Tramways owing to the difficulty experienced by the local authorities in obtaining delivery of material. The line is now opened as far as Waterloo, and it is expected it will be completed to Crosby in about two months. The traffic on the portion opened has been satisfactory. The Bill in Parliament, promoted by the company for the purpose of extending the main line to the Seaforth station of the Lancashire and Yorkshire Railway, has passed both Houses of Parliament, and will, in due course, receive the Royal Assent. The capital authorised at the last half-yearly meeting was offered to the shareholders on June 25th last, in 5,000 ordinary £10 shares, at £8 per share, and applications were received for considerably more than the amount required.

Revenue Account.

	£ s. d.
Receipts from passenger traffic amount to	37,404 5 5
Miscellaneous receipts and interest	719 15 9
	38,124 1 2
Less working expenses	25,113 3 9
	13,010 17 5
Deduct interest on mortgage debentures	3,400 0 0
	9,610 17 5
Add balance brought forward, December 31st, 1899 ..	4,591 14 7
Leaving available for dividend	14,202 12 0

Revenue Account, Half-year ended June 30th, 1900.

Half-year ended June 30th, 1899.	Expenditure.		£ s. d.
£ s. d.			
4,108 17 10	To Maintenance of way, works and stations—	*Abstract A*	3,993 3 0
6,746 15 0	„ Locomotive power	„ *B*	7,188 18 1
715 1 3	„ Repairs and renewals of carriages	„ *C*	444 3 6
9,064 10 7	„ Traffic expenses..	..	9,276 12 0
2,310 3 6	„ General charges	..	2,143 15 3
55 4 6	„ Law charges	..	70 9 6
65 9 6	„ Compensation	..	16 6 9
1,886 5 0	„ Rents, rates, and taxes	..	1,905 4 10
71 18 6	„ Government duty	..	74 10 10
24,924 5 8			25,113 3 9
11,568 1 9	„ Balance carried to net revenue account ..		12,909 7 9
£36,492 7 5			£38,022 11 6

Half-year ended June 30th, 1899.	Receipts.		£ s. d.
£ s. d.			
35,960 5 3	By Passenger traffic..		37,404 5 5
		Half-year ending June 30th, 1899.	Half-year ending June 30th, 1900.
	1st class.. ..	594,669	635,449
	2nd class, including tramways	2,445,573	2,477,025
	Workmen ..	1,435,038	1,575,388
	Total No. passengers	4,475,279	4,687,862
43 4 3	„ Parcels, &c...		40 5 7
468 12 11	„ Rents		565 2 8
20 5 0	„ Transfer fees		12 17 10
£36,492 7 5			£38,022 11 6

Abstracts.

(*A*)—Maintenance of Way Works, &c.

Half-year ended June 30th, 1899.		£ s. d.	£ s. d.
£ s. d.			
	Maintenance and renewal of permanent way—		
718 2 2	Wages	585 13 3	
160 15 6	Material	336 1 9	
			921 15 0
1,300 0 0	Repairs of structure and opening bridges		1,103 1 3
630 0 2	Repairs of stations and buildings ..		468 6 9
1,300 0 0	Provision for renewal of boilers, machinery at generating station, permanent way, &c...		1,500 0 0
6·57	Miles maintained—Double	6·57	
£4,108 17 10			£3,993 3 0

(*B*)—Locomotive Power.

Half-year ended June 30th 1899		£ s. d.	£ s. d.
£ s. d.			
	Running expenses—		
3,087 9 4	Wages connected with the working of generating engines and motors ..	3,060 10 4	
1,636 7 6	Coal and coke	1,595 5 8	
423 3 4	Oil, tallow, and other stores	643 4 7	
			5,299 0 7
5,147 0 2	Repairs and renewals—		
597 18 9	Wages	617 15 11	
1,001 16 1	Materials	1,272 1 7	
			1,889 17 6
£6,746 15 0			£7,188 18 1

(*C*)—Repairs and Renewals of Carriages.

Half-year ended June 30th, 1899.		£ s. d.	£ s. d.
£ s. d.			
	Carriages—		
379 16 6	Wages	301 19 2	
335 4 9	Materials	142 4 4	
			444 3 6
£715 1 3			£444 3 6

(*D*)—Traffic Expenses.

Half-year ended June 30th, 1899.		£ s. d.	£ s. d.
£ s. d.			
5,972 14 7	Salaries and wages, &c.		6,035 6
2,288 15 5	Fuel, lighting, signalling, water, and general stores		2,446 6 4
256 8 11	Clothing		224 11 6
596 11 8	Printing, stationery, and tickets		570 8 2
£9,064 10 7			£9,276 12 0

Mileage Statement.

Miles worked by engines, half-year ending June 30th, 1899.	—	Miles authorised.	Miles constructed	Miles constructing or to be constructed.	Miles worked by engines.
M. C.		M. C.	M. C.	M. C.	M. C.
6 57	Lines leased by company	7 5	6 57	Nil	6 57
„	(tramways)	2 40	1 8	1 32	1 8

Statement of Train Mileage.

Half-year ending June 30th, 1899.		
375,500	Passenger trains	400,092
Nil.	Tramways	2,344

Stock Exchange Notices.—The Committee has ordered the following securities to be quoted in the Official List:—British Aluminium Company—20,000 7 per cent. cumulative preference

shares, £10 fully paid, Nos. 1 to 20,000. Application has been made to appoint a special settling day in and to grant a quotation to:—Castner Electrolytic Alkali Company (of the U.S. of America), £200,000 5 per cent. first mortgage sterling debentures of £100 each. County of London and Brush Provincial Electric Lighting Company, Limited—Provisional certificates for £100,000 4½ per cent. debenture stock. R. Waygood & Co., Limited—70,000 ordinary shares of £1 each, and 70,000 6 per cent. cumulative preference shares of £1 each. To appoint a special settling day in:—Calcutta Electric Supply Corporation, Limited—Further issue of 10,000 shares of £5 each. And to allow the following securities to be quoted in the Official List:—Crompton & Co., Limited—Further issue of 21,902 ordinary shares of £3 each, fully paid, Nos. 32,099 to 54,000. The Committee has appointed Tuesday, August 14th, as a special settling day in, and has granted a quotation in the Official List to:—Callender's Cable and Construction Company, Limited—Further issue of 20,000 5 per cent. cumulative preference shares of £5 each, fully paid, Nos. 20,001 to 40,000.

Smithfield Markets Electric Supply Company.—A circular issued by the directors to the shareholders states that the business of the company has progressed and is still progressing satisfactorily. Since the commencement of the year the lamps connected have steadily increased, while within the past few weeks 30 new installations have been obtained in the Central Markets. The number of units sold for the half-year amounted to 367,306, against 174,827 for the corresponding six months in 1899. The directors feel justified in hoping that the result of the current year's working will show a substantial improvement upon the previous year, notwithstanding the high price of coal and the probability of still further advances.

Elmore's Trust.—A meeting of the shareholders of the above company was held on Friday, August 3rd, at the Cannon Street Hotel, but on the representative of the Electrical Review presenting himself, he was informed it was private.

North Staffordshire Tramways Company.—A meeting of this company was held at Donington House, Norfolk Street, on Thursday last week. Our representative was informed that the proceedings were private.

Hove Electric Lighting Company, Limited.—The directors have declared an interim dividend at the rate of 7 per cent. per annum upon the share capital of the company, for the half-year ending June 30th last. The dividend will be paid as usual on October 15th next.

Westminster Electric Supply Corporation.—The directors have declared an interim dividend at the rate of 10 per cent. for the half-year ending June 30th last, payable on September 1st next.

British Insulated Wire Company.—The directors have declared an interim dividend at the rate of 10 per cent. per annum for the half-year ended 30th ult.

Personal.—Mr. H. Rogers has been appointed secretary of the Rand Central Electric Works, Limited, vice Mr. H. Militz, resigned.

TRAFFIC RECEIPTS.

The Blackpool and Fleetwood Tramroad Company.—The receipts for the week ending August 4th, 1900, were £1,290 12s. 9d.; receipts for corresponding period, 1899, £1,359 13s. 8d.; aggregate for half-year to date, £5,883 0s. 6d.; aggregate corresponding period of last half-year, £3,813 5s. 7d.

The Bristol Tramways and Carriage Company, Limited.—The receipts for the week ending August 3rd, 1900, were £3,451 5s. 1d.; corresponding period, 1899, £3,660 7s. 2d.; decrease, £209 0s. 1d.

The Central London Railway.—The receipts for the week ending August 4th, 1900, were £4,323; miles open, 6.

The City and South London Railway Company.—The receipts for the week ending August 5th, 1900, £11,541; August 6th, 1899, £983; increase, £608. Total receipts for half-year, 1900, to date, £7,446; corresponding period, 1899, £4,654; increase, £2,792. Miles open, 1900, 4½; 1899, 3½.

The Cork Electric Tramways and Lighting Company, Limited.—The receipts for the week ending Thursday, August 2nd, 1900, were £525 5s. 8d.; corresponding week last year, £519 17s. 6d.; increase, £5 8s. 2d. Total to August 2nd, 1900, £12,140 14s. 7d.; corresponding period last year, £10,918 14s. 11d.; increase, £1,221 19s. 8d.

The Dover Corporation Tramways.—The receipts for the week ending August 4th, 1900, were £275 16s. 4d.; August 5th, 1899, £272 9s. 11d.; increase, £3 6s. 5d. Total receipts to date, 1900, £5,889 5s. 0d.; corresponding period, 1899, £5,585 5s. 7d.; increase, £353 19s. 5d. Miles of track open, 1900, 8; 1899, 3. Car miles run, 1900, 5,043; 1899, 4,553. Number of cars, 1900, 11; 1899, 11.

The Dublin United Tramways Company.—The receipts for the week ending Friday, August 3rd, 1900, were as follows:—D. U. T. Co., horse cars, £31 4s. 3d.; ditto, electric cars, £3,923 6s. 8d.; D. S. D. Co., electric cars, £1,045 14s. 3d.; total, £5,000 5s. 2d; corresponding week last year—D. U. T. Co., horse cars, £2,246 19s. 0d.; ditto, electric cars, £1,265 18s. 8d.; D. S. D. Co., electric cars, £1,155 8s. 8d.; total, £4,668 5s. 11d.; increase, £331 19s. 3d.; aggregate to date, £24,557 18s. 11d.; aggregate to date last year, £22,965 9s. 11d.; increase to date, £2,322 9s. 0d. The mileage worked is 43 miles electrically, 1 mile by horses, as against 18 miles electrically, 26 miles by horses, for the corresponding period last year.

The Halifax Corporation Tramways.—The receipts for the week ending August 5th, 1900, were £872; corresponding period, 1899, £667; increase, £205. Total receipts to date, 1900, £13,945; corresponding period, 1899, £10,561; increase, £3,384. Miles of track open, 1900, 14; 1899, 6½. Number of cars, 1900 29 1899, 14.

The Liverpool Overhead Railway Company.—The receipts for the week ending August 5th, 1900, were £1,635; corresponding week last year, £1,654; decrease, £19. Total traffics from July 1st, 1900, £8,499; ditto corresponding period 1899, £7,593; increase, £506. Miles open 6·57 chains.

STOCKS AND SHARES.

Wednesday Evening.

Again has the electrical railway market provided the principal interest in the departments upon which we touch in these notes. Central London Undivided have come prominently to the fore on the report to which we alluded last week. Moreover, the line has so captivated the popular fancy that it is doing a thriving business, and if present traffics are maintained the directors' anticipations will be far surpassed. But it is too early yet to form a sound judgment as to how the line will prosper in the future. In the Stock Exchange the market in the shares is broadening out, and lively dealings take place every day, a very different state of things to that prevailing in Waterloo and City stock. That security has again fallen sharply, in sympathy with its parent stock, London and South-Western. Those who took our hint a couple of months ago and sold the stock in the neighbourhood of par need be in no hurry to repurchase yet awhile.

Districts and Metropolitans are both a point down since we last wrote, and the Omnibus descriptions are also suffering. Shareholders in London's traffic-carriers have no cause at present to bless the new "Tube."

A fall of 10s. in Westminster Electrics is the only change of any consequence that has taken place in supply shares. The latest issue has now been admitted to quotation in the Official List, and the price is 9¼. Charing Cross and Strand are quoted *ex rights*. The value of the privilege was problematical. Chelsea Debenture has been sought for, and is marked up 1 per cent., but business in this section is extremely slow. Smithfield Electrics can be sold at 2, but the buyers refuse to offer more. The company's report, out the other day, speaks of progress, but there is to be no dividend on the Ordinary shares. Edmundson's is offering a few 6 per cent. Preference shares at 5¼. The security appears to be ample, and the investment a good one. Had the issue been made 12 months ago it would have achieved a great success, but of late the investor's palate has been tickled with such bargains that it has grown very fastidious.

Notting Hill shares show no change on the directors' decision to issue new Ordinary shares at £12, or 50s. below the price at which the existing Ordinaries stand. Metropolitans, nominally unchanged, are really stronger, the decision of the Marylebone Vestry to purchase part of the company's undertaking having strengthened the market. The official quotation, as we say, is unaltered: another illustration of the misleading character of such prices. Brush shares are appreciably better on the report, but the First Debenture stock has fallen a point. Electric Construction are flat, the rising price of copper being put forward as a reason for the relapse.

Edison & Swan "A" shares are unaffected by the danger which Mr. Forbes, the company's chairman, apprehends. The company's Second Debenture stock, 70 per cent. paid, is quoted 2 per cent. either side of par, *i.e.*, 68 to 72.

It would be well for holders of Anglo-American Telegraph Deferred stock to consider whether they might not use their money to more advantage than by having it invested in Anglo "A." It takes £35,000 to pay 1 per cent. dividend on this stock, and seeing that the company will probably lose at least £25,000 for the year in connection with the ship *Minia*, it seems likely that the Deferred dividend will suffer, particularly with the new German competitor starting work next month. Of course it is quite possible that, even if the "A" stock got no dividend at all, the price might be maintained. We have no information beyond what is contained in the report, but on that document it seems to us that the "A" stock cannot be called cheap at its present quotation of 12.

A syndicate is being formed for the purpose of raising funds to work electric and other concessions in Tasmania. The scheme is well backed, but at present is in its primitive stages. More will be heard about it when the promoters and capitalists return from the summer holidays.

Rapid progress is being made by the London United Tramways Company with its installations at Hammersmith and Shepherd's Bush. Those two places are a very hive of electrical industry of all kinds, and the overhead tramlines are the most prominent tokens of it. Imperial Tramway shares should be worth an investor's notice, since they will get whatever benefit it derives from the new traction on the London United lines. British Electric have been freely dealt in this week, but the price is without particular change.

SHARE LIST OF ELECTRICAL COMPANIES.—TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1897.	1898.	1899.	Closing Quotation August 1st.	Closing Quotation August 8th.	Business done during week ended August 8th, 1900. Highest.	Lowest.
110,900	African Direct Telegraph, 4 % Debs.	100	...	...	...	99 —103	99 —103	...	...
125,000	Amazon Telegraph 5 % Debs., Nos. 1 to 1,250 Red.	100	...	...	...	85 — 90	85 — 90	...	...
875,520	Anglo-American Telegraph	Stock	3 %	£3 9s.	73/6	58 — 61 xd	58 — 61	58½	...
3,062,240	Do. do. 6 % Pref.	Stock	6 %	6 %	6 %	110½ 111½xd	110½—111½	111½	110½
3,062,240	Do. do. Deferred	Stock	...	18s. %	£1 7s.	11⅞— 12¼	12 — 12⅛	12¼	12 5/16
44,000	Chili Telephone, Nos. 1 to 44,000	5	4 %	3 %	4 %	2⅞— 3⅛	2⅞— 3⅛	...	...
10,000,000$	Commercial Cable	$100	8 %	8 %	...	165 —175	165 —175	...	...
1,563,078£	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	...	...	...	101 —103	101 —103	102½	...
16,000	Cuba Telegraph	10	7 %	8 %	7 %	6½— 7½	6½— 7½	7 7/16	...
6,000	Do. 10 % Pref.	10	10 %	10 %	...	15 — 16	15 — 16	...	...
12,931	Direct Spanish Telegraph	5	4 %	4 %	...	4 — 5	4 — 5	...	...
6,000	Do. do. 10 % Cum. Pref.	5	10 %	...	...	9 — 10	9 — 10	...	...
30,000	Do. do. 4½ % Debs.	50	...	...	...	100 —104 %	100 —104%	...	...
60,710£	Direct United States Cable	20	3¼%	3¼%	3 %	11¼— 11⅝	11¼— 11⅝	11¼	11¼
111,000	Direct West India Cable, 4½ % Reg. Deb.	100	...	...	...	99 —102	99 —102	...	...
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	7 %	145 —150	145 —150	149	145½
1,795,000	Do. 3½ % Pref. Stock	100	...	...	...	96 — 99	96 — 99	99	97
1,432,268£	Do. 4 % Mort. Deb. Stock Red.	Stock	4 %	...	...	111 —116	111 —116	...	...
250,000	Eastern Extension, Australasia, and China Telegraph	10	7 %	7 %	7 %	14½— 15	14½— 15	15	14⅞
6,700£	Do. 5 % (Aus. Gov. Sub.) Deb., 1900, red. ann. drgs., reg. 1—1,049, 3,976—4,326	100	5 %	...	...	... — ...	... — ...	...	...
26,600£	Do. do. Bearer, 1,050—3,975, 4,327—6,400	100	5 %	...	...	... — ...	... — ...	...	...
320,000£	Do. 4 % Deb. Stock	Stock	4 %	...	...	110 —115 xd	110 —115	...	...
300,000£	Eastern and South African Telegraph, 4 % Mort. Deb. Nos. 1 to 3,000, red. 1909	100	...	...	...	99 —102 xd	99 —102	...	...
200,000£	Do. 4 % Reg. Mt. Debs. (Mauritius Sub.) 1—8,000	25	...	...	...	100 —103%	100 —103%	...	...
180,227	Globe Telegraph and Trust	10	4⅛%	5⅛%	5¼%	11¼—11⅜	11¼— 11⅜	11⅜	11⅜
180,042	Do. do. 6 % Pref.	10	6 %	6 %	...	15 — 15½	15 — 15½	15 9/16	15
150,000	Great Northern Telegraph, of Copenhagen	10	10 %	12½%	...	31 — 33	31 — 33	33	...
84,300	Halifax and Bermuda Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	...	...	...	98 —101	98 —101	...	...
17,000	Indo-European Telegraph	25	10 %	10 %	10 %	52 — 56	52 — 56	54	...
100,000£	London Platino-Brazilian Telegraph, 6 % Debs.	100	6 %	...	...	105 —108	105 —108	...	...
72,680	Montevideo Telephone, Limited, Ord., Nos. 1 to 72,680	1	...	...	...	¼— ⅜	¼— ½	...	...
86,492	Do. do. do. 5 % Pref., Nos. 1 to 86,492	1	4 %	4 %	2½%	¾— 1	¾— 1	...	...
490,000	National Telephone, 1 to 490,000	5	6 %	6 %	5 %	4¾— 5 xd	4¾— 5	4 15/16	4¾
15,000	Do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	12 — 14 xd	12 — 14	...	...
15,000	Do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	12 — 14 xd	12 — 14	...	...
250,000	Do. 5 % Non-cum. 3rd Pref., 1 to 250,000	5	5 %	5 %	6 %	4⅞— 5⅛xd	4⅞— 5⅛	5 1/16	5
2,000,000£	Do. 3½ % Deb. Stock Red.	Stock	3½%	3½%	3½%	97 —100	97 —100	...	...
171,504	Oriental Telephone and Elec., Nos. 1 to 171,504, fully paid	1	5 %	5 %	5 %	⅞— 1⅛	⅞— 1⅛	...	...
100,000£	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000	100	4 %	...	...	100 —103	100 —103	...	...
11,839	Reuter's	8	5 %	5 %	5 %	7½— 8½	7½— 8½	...	...
3,381	Submarine Cables Trust	Cert.	...	...	...	125 —130	125 —130	...	...
58,000	United River Plate Telephone	5	5 %	6 %	7 %	4¾— 5¼	4¾— 5¼	5	...
16,639	Do. do. 5 % Cum. pref. Nos. 1—16,639	5	...	...	...	5 — 5½	5 — 5½	...	...
179,947	Do. do. 5 % Debs.	Stock	...	...	...	104 —107	104 —107	...	...
200,000£	West African Telegraph, 5 % Debs.	100	...	...	...	98 —101	98 —101	...	...
30,008	West Coast of America, Nos. 1—30,000 and 53,001—53,008	2½	...	...	...	½— 1	½— 1	¾	...
150,000	Do. do. 4 % Debs., 1—1,500 gua. by Braz. Sub. Tel.	100	...	...	...	99 —102	99 —102	99	...
389,731	Western and Brazilian Telegraph 4 % Deb. Stock Red.	Stock	...	...	...	... — ...	... — ...	...	...
207,930	Western Telegraph, Ltd., Nos. 1—207,930	10	7 %	7 %	...	14⅜—15¼ xd	14⅜— 15¼	15	14⅞
75,000	Do. do. 5 % Debs. 2nd series, 1906	100	...	...	...	103 —106	103 —106	...	...
88,321	West India and Panama Telegraph	10	3¾%	2 %	6%	⅝— ⅞	⅝— ⅞	...	...
34,563	Do. do. do. 6 % Cum. 1st Pref.	10	6 %	...	...	6½— 7½	6½— 7½	...	...
4,669	Do. do. do. 6 % Cum. 2nd Pref.	10	6 %	...	...	6 — 7	6 — 7	...	...
80,000£	Do. do. do. 5 % Debs., Nos. 1 to 1,800	100	5 %	...	...	102 —105	102 —105	...	...

ELECTRICITY SUPPLY COMPANIES.

19,661	Brompton & Kensington Elec. Lt. Sup., Ord., 101 to 19,761	5	4 %	6 %	6 %	7 — 8	7 — 8	...	...
12,000	Do. do. 7 % Cum. Pref.	5	7 %	...	...	8½— 9½	8½— 9½	...	...
50,000	Charing Cross and Strand Electricity Supply	5	7 %	8 %	9 %	9½— 10½	9½— 10½	..	...
20,000	Do. do. do. 4½% Cum. Pref.	5	...	...	...	5½— 5⅝	5½— 5⅝	...	...
34,000	*Chelsea Electricity Supply, Ord.	5	6 %	6 %	6 %	6½— 7⅛	6½— 7⅛	...	...
150,000	Do. do. do. % Deb. Stock Red.	Stock	4½%	...	...	107 —110	108 —111	110	109¼
60,000	City of London Electric Lighting, Ord. 40,001—100,000	10	10 %	6 %	4 %	8 — 9	8 — 9	8½	...
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	...	11½—12½ xd	12 — 13	...	...
400,000	Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid	...	5 %	...	...	123 —128	123 —128	125	...
40,000	County of Lond. & Brush Prov. Elec. Ltg., Ord. 1—40,000	10	*nil*	*nil*	4 %	8½— 9½	8½— 9½	...	...
20,000	Do. do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	...	11½— 12½	11½— 12½	...	...
200,000	Do. 4½ % Deb. Stock, Prov. Certs (all paid) Rd.	...	...	...	...	107 —110	107 —110	...	...
26,100	Edmundson's Elec. Corp., Ord. Shares	5	5 %	7 %	...	4½— 5	4½— 5	4 9/16	...
75,000	Do. do. 4½ % 1st Mort. Deb. Stock.	100	...	...	...	99 —102	99 —102	...	...
110,000	London Electric Supply Corporation, Limited, Ord.	3	...	...	...	1 — 1⅛	1 — 1⅛	...	...
49,840	Do. do. do. do. 6 % Pref.	5	...	6 %	...	4 — 4½	4 — 4½	...	...
250,000	Do. do. do. 4% 1st Mt. Db. Stock Rd.	Stock	...	...	...	98 —100	98 —100	...	...
85,000	Metropolitan Electric Supply, 101 to 62,500	10	6 %	5 %	5 %	14½— 15½	14½— 15½	15	14⅞
220,000£	Do. 4½% First Mortgage Debenture Stock	...	4½%	...	...	111 —114	111 —114	...	...
220,000	Do. 3½% Mort. Deb. Stock Red.	Stock	...	...	...	96 — 98	96 — 98	...	...
6,452	Notting Hill Electric Lighting	10	6 %	6 %	7 %	15½— 16½	15½— 16½	...	...
40,000	St. James's and Pall Mall Electric Light, Ord.	5	14½%	14½%	14½%	14 — 15 xd	14 — 15	14⅝	14⅜
20,000	Do. do. 7 % Pref., 20,081 to 40,080	5	7 %	7 %	7 %	8 — 9 xd	8 — 9	8⅝	...
12,000	Smithfield Market Elect. Supply, Ord.	5	...	...	...	2 — 2¼	2 — 2⅛	2	1 5/16
50,000	Do. do. 4 % Deb.	100	...	...	...	85 — 95 xd	85 — 95	...	...
65,000	South London Electricity Supply, Ord.	5	...	...	...	3 — 4	3 — 4	...	...
79,900	Westminster Electric Supply, Ord., 101 to 80,000	5	12 %	12 %	13 %	12½— 13½	12 — 13	12⅞	12½

* Subject to Founders Shares.
‡ Unless otherwise stated all shares are fully paid.
† Quotations on Liverpool Stock Exchange.
‖ Dividends paid in deferred share warrants, profits being used as capital.
Dividends marked ‖ are for a year consisting of the latter part of one year and the first part of the next.

SHARE LIST OF ELECTRICAL COMPANIES.—*Continued.*

ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL COMPANIES.

Present Issue.	NAME.	Stock or Share.	Dividends for the last three years. 1897.	1898.	1899.	Closing Quotation Aug. 1st.	Closing Quotation Aug. 8th.	Business done week ended Aug. 8th, 1900. Highest.	Lowest.
		‡							
65,000	Aluminium shares, Nos. 1—65,000	1	10 %	20 %	...	2⅜— 3¼	2⅞— 3⅛	3	...
90,000	Do. 4½ % 1st Mort. Deb. Stock Red.	Stock	...	...	...	96 —101	96 —101	...	...
30,000	British Electric Traction	10	...	6 %	...	14 — 15	14 — 15	14⅝	14½
50,000	Do. do. 6 % Cum. Pref.	10	...	...	...	12 — 13	12 — 13	12 13/16	12½
200,000	Do. do. 5 % Perpetual Debenture Stock	Stock	...	...	...	123 —126	123 —126	125½	125
85,000*l*	†British Electric Works Co., Ord. £1 shares, 50,001—135,000	...	...	...	...	¾— ⅞	¾— ⅞	...	...
50,000	† Do do. 6 % Cum.Pref., 1—50,000	...	...	...	...	1 3/16— 1 5/16	1 3/16— 1 5/16	...	...
500	† Do. do. 4½ % 1st Mort. Deb.	100	...	...	...	97 — 99	97 — 99	...	...
40,000	British Insulated Wire Ord., Nos. 1 to 40,000	5	15 %	15 %	20 %	11½— 12½xd	11½— 12½	...	...
27,500	Do. do. 6 % Cum. Pref. Nos. 1 to 27,000	5	...	...	...	5¾— 6¼xd	5¾— 6¼	...	...
90,000	Brush Elecl. Enging., Ord., 1 to 90,000	3	3 %	5 %	...	1⅝— 1⅞	1⅝— 1⅞	...	...
90,000	Do. do. Non-cum. 6 % Pref., 1 to 90,000	2	6 %	6 %	...	2 — 2¼	2⅛— 2⅜	2 5/16	2 3/16
125,000*l*	Do. do. 4½ % Perp. Deb. Stock	Stock	...	...	...	109 —114	108 —113	...	...
50,000	Do. do. 4½ % 2nd Deb. Stock Red	Stock	...	...	...	101 —103	101 —103	...	...
20,000	Callender's Cable Construction shares, Nos. 1—20,000	5	12½%	15 %	15 %	13 — 14	13 — 14	...	...
20,000	Do. do. 5 % Cum. Pref.	5	...	...	...	5¼— 5⅜	5¼— 5⅜	...	...
90,000	Do. do. 4½ % 1st Mort. Deb. Stock Red	S ock	...	...	...	110 —114	110 —114	...	...
213,533	Central London Railway, Ord. Shares	10	...	...	...	9½— 10	10 — 10⅛	10⅜	9⅞
61,033	Do. do. Pref. half-shares	5	...	...	...	4½— 5	5 — 5⅛	5⅛	5 1/16
71,447	Do. do. Def. do.	5	...	...	...	4½— 5	5 — 5⅛	5 9/16	5 1/16
855,000	City and South London Railway	Stock	1⅞%	2⅛%	1⅞%	56 — 59	56 — 59	59	...
37,500	Do. do. Ord. shares Nos. 22,501 to 60,000	10	...	...	...	6 — 7	6 — 7	...	...
32,098	Crompton & Co., Nos. 1 to 32,098	3	...	6 %	7½%	3¾— 4¼	3¾— 4¼	...	...
100,000	Do. 5 % 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 red	...	...	...	...	99 —102	99 —102	101¼	100¾
99,261	Edison & Swan Utd. El. Lgt., "A" shares, £3 pd. 1 to 99,261	5	6 %	6 %	6 %	2 — 2⅛	2 — 2⅛	2 1/16	...
17,139	Do. do. do. "A" Shares, 01—017,139	5	6 %	6 %	6 %	3½— 4⅛	3½— 4⅛	...	...
344,023	Do. do. do. 4 % Deb. Stock Red	100	...	...	...	91 — 93	91 — 93	...	...
112,100	Electric Construction, 1 to 112,100	2	6 %	6 %	6 %	2 — 2¼xd	1⅞— 2⅛	...	...
25,000	Do. do. 7 % Cum. Pref., 1 to 25,000	2	7 %	7 %	...	2⅜— 3¼xd	2⅜— 3¼	...	...
140,300	Do. do. 4 % Perp. 1st Mort. Deb. Stock	Stock	...	...	...	102 —105	102 —105	...	...
9,600*l*	Greenwood & Batley, 7 % Cum. Pref., 1 to 9,600	10	7 %	7 %	7 %	10 — 11	10 — 11	...	...
30,000	Henley's (W. T.) Telegraph Works, Ord.	5	12 %	14 %	15 %	13 — 14	13 — 14	13¼	...
30,000	Do. do. do. 4½ % Pref.	5	7 %	7 %	...	5¼— 5⅜	5¼— 5⅜	...	...
50,000	Do. do. do. 4½ Mort. Deb. Stock	Stock	4½%	...	...	110 —114	110 —114	...	...
50,000	India-Rubber, Gutta-Percha and Telegraph Works	10	10 %	10 %	...	21 — 22	21 — 22	...	...
300,000	Do. do. do. 4 % 1st Mort. Deb	100	...	...	...	101 —104	101 —104	...	...
37,500	†Liverpool Overhead Railway, Ord.	10	3¼%	3¼%	3⅜%	9⅛— 9¼	9 3/16— 9 5/16	...	...
10,000	† Do. do. Pref., £10 paid	10	5 %	5 %	5 %	13 — 13½	13¼— 13½	...	...
37,350	Telegraph Construction and Maintenance	12	15 %	15 %	15 %	35 — 39xd	35 — 39	35	...
150,000	Do. 4 % Deb. Bds. Nos. 1 to 1,500 Red. 1909	100	...	...	...	101 —104	101 — 104	...	...
20,000	Telegraph Manufacturing, Ord. Nos. 1 to 20,000	5	...	8 %	12 %	10 — 11	10 — 11	...	...
20,000	Do. do. 5 % Cm. Prf. Nos. 1 to 20,000	5	...	...	...	5¼— 5⅜	5¼— 5⅜	5⅝	...
540,000*l*	Waterloo and City Railway, Ord. Stock	100	...	3 %	3 %	93 — 96	90 — 93	...	...

† Quotations on Liverpool Stock Exchange.

‡ Unless otherwise stated all shares are fully paid.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

*Birmingham Electric Supply, Ordinary £5 (fully paid) 8—10.
Brompton and Kensington, 4½ % Debentures of £100, 104—106.
National Electric Free Wiring, 12/6 paid, ⅜—½.
Oldham, Ashton, and Hyde Electric (£10 pd.), Ord., 17½—18½.
Do. do. Pref. (£10 pd.), 10—11.

* From Birmingham Share List.

Kensington and Knightsbridge Electric Lighting, Ordinary Shares £5 (fully paid) 12—13; 1st Preference Cumulative 6 % £5 (fully paid), 7—7½. Debentures, 102—104. Dividend, 1899, on Ordinary Shares 11 %.
*T. Parker, £10 (fully paid), 17½.

Bank rate of discount 4 per cent. (July 19th, 1900).

MARKET QUOTATIONS, Wednesday, August 8th.

CHEMICALS, &c.		This week.	Last week.	Inc. or Dec.
a Acid, Hydrochloric	per cwt.	5/-	5/-	..
a ,, Nitric	per cwt.	22/-	22/-	..
a ,, Oxalic	per cwt.	32/-	32/-	..
a ,, Sulphuric	per cwt.	5/6	5/6	..
a Ammoniac, Sal	per cwt.	39/-	39/-	..
a Ammonia, Muriate (crystal)	per ton	£33	£33	..
a ,, ,,	per ton	£30	£30	..
a Bleaching powder	per ton	£7	£7	..
a Bisulphide of Carbon	per ton	£15	£15	..
a Borax	per ton	£17	£17	..
a Bensole (90 %)	per gal.	7/-	7/-	..
a ,, (50/90%)	per gal.	5/6	5/6	..
a Copper Sulphate	per ton	£25 10	£25 10	..
a Lead, Nitrate	per ton	£25	£25	..
a ,, White Sugar	per ton	£31	£31	..
a ,, Peroxide	per ton	£27 10	£27 10	..
a Methylated Spirit	per gal.	2/6	2/6	..
a Naphtha, Solvent (90% at 160° C).	per gal.	5/6	5/6	..
a Potash, Bichromate, in casks.	per lb.	3¼d.	3¼d.	..
a ,, Caustic (75/80%)	per ton	£24	£24	..
a ,, Bisulphate	per ton	£35	£35	..
a Shellac	per cwt.	68/-	68/-	..
a Sulphate of Magnesia	per ton	£4 10	£4 10	..
a Sulphur, Sublimed Flowers	per ton	£6	£6	..
a ,, Recovered	per ton	£5 10	£5 10	..
a ,, Lump	per ton	£5	£5	..
a Soda, Caustic (white 70 %)	per ton	£10 15	£10 15	..
a ,, Crystals	per ton	£3	£3	..
a ,, Bichromate, casks	per lb.	3¾d.	3¾d.	..
METALS, &c.				
b Aluminium Wire, in ton lots	per ton	£224	£224	..
b ,, Sheet, in ton lots	per ton	£191	£191	..
p Babbitt's metal ingots	per ton	£80 to 150	£80 to £150	..
c Brass (rolled metal 3" to 12") basis	per lb.	7¾d.	7¾d.	..
c ,, Tube (brazed)	per lb.	10d.	10d.	..
c ,, ,, (solid drawn)	per lb.	8¼d.	8¼d.	..
c ,, Wire, basis	per lb.	8¼d.	8¼d.	..
c Copper Tubes (brazed)	per lb.	11¼d.	11¼d.	..
c ,, ,, (solid drawn)	per lb.	11d.	11d.	..
g Copper Bars (best selected)	per ton	£85	£84	20s. inc.

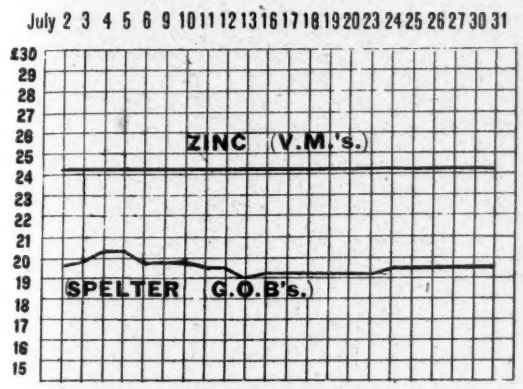
METALS, &c. *(continued.)*		This week.	Last week.	Inc. or Dec.
g Copper Sheet	per ton	£85	£84	£1 inc.
g ,, Rod	per ton	£85	£84	£1 inc.
e ,, (Electrolytic) Bars	per ton	£82 10	£82 10	..
e ,, ,, Sheets	per ton	£90	£90	..
e ,, ,, Rod	per ton	£84	£84	..
e ,, ,, H.C. Wire	per lb.	9¼d.	9¼d.	..
f Ebonite Rod	per lb.	3/-	3/-	..
f ,, Sheet	per lb.	5/-	5/-	..
n German Silver Wire	per lb.	1/6	1/6	..
h Gutta-percha fine	per lb.	..	..	..
h India-rubber, Para fine	per lb.	3/10½ to 4/0½	3/10½ to 4/0½	..
i Iron, Charcoal Sheets	per ton	£18	£18	..
i ,, Pig (Cleveland warrants)	per ton	69/6	69/6	..
i ,, Forgings, according to size	per ton	From £11	From £11	..
i ,, Scrap, heavy	per ton	70/- to 72/6	70/- to 72/6	..
i ,, Wire, galvanised No. 8	per ton	£12 15	£12 15	..
g Lead, English Ingot	per ton	£17 12 6 to £17 17 6	£18 2 6 to £18 5	dec.
g ,, ,, Sheet	per ton	£19	£18 15	5s. inc.
m Manganin Wire No. 28	per lb.	8/-	8/-	..
g Mercury	per bot.	£9 10	£9 10	..
d Mica (in original cases), small	per lb.	3d. to 9d.	3d. to 9d.	..
d ,, ,, ,, medium	per lb.	1/9 to 2/9	1/9 to 2/9	..
d ,, ,, ,, large	per lb.	3/3 to 7/3	3/3 to 7/3	..
p Phosphor Bronze, plain castings	per lb.	1/1 to 1/4	1/1 to 1/4	..
p ,, rolled bars & rods	per lb.	1/1 to 1/4	1/1 to 1/4	..
p ,, ,, strip & sheet	per lb.	From 1/3	From 1/3	..
o Platinum	per oz.	£3 13 6	£3 13 6	..
p Silicon Bronze Wire	per lb.	10½d. to 1/1	10½d. to 1/1	..
i Steel, Magnet, acc'd'ng to desc'p'n	per ton	From £15 to £40	From £15 to £40	..
i ,, ,, in bars		£58	£58	..
g Tin, block	per ton	£147 to £148	£146 to £147	£1 inc.
g ,, foil	per lb.	2/-	1/9	3d. inc.
n ,, wire, Nos. 1 to 16	per lb.	1/9	1/9	..
p White Anti-friction Metals — "White Ant" brand	per ton	£40 to £70	£40 to £70	..
j Yarns, Cotton, Single 10 lb b'ndl's	per lb.	8¼d.	8¼d.	..
j ,, Best Flax, 6 lea.	per lb.	6d.	6d.	..
j ,, Hemp, 3 ply 10 lbs.	per lb.	4½d.	4½d.	..
j ,, ,, Russian, 10 lbs.	per lb.	5¾d.	5¾d.	..
j ,, Jute, 180 lbs. rove	per ton	£14	£14	..
k Zinc, Sh't. (Vielle Montague ond.)	per ton	£24 5 nett.	£24 5 nett.	..

Quotations supplied by { *a* Messrs. G. Boor & Co. *b* The British Aluminium Co., Ltd. *c* Messrs. Thos. Bolton & Sons. *d* Messrs. F. Wiggins & Sons. *e* Messrs. Frederick Smith & Co.

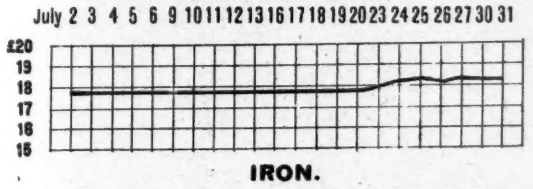
Quotations supplied by { *f* India-Rubber, G.-P. and Teleg. Works *g* Messrs. James & Shakspeare. [Co., Ltd. *h* Messrs. Jackson & Till. *i* Messrs. Bolling & Lowe. *j* Messrs. Henry C. Yeo & Co.

Quotations supplied by { *k* Messrs. Morris Ashby, Limited. *m* Messrs. W. T. Glover & Co., Ltd. *n* Messrs. P. Ormiston & Sons. *o* Messrs. Johnson, Matthey & Co., Ltd. *p* The Phosphor Bronze Company, Ltd.

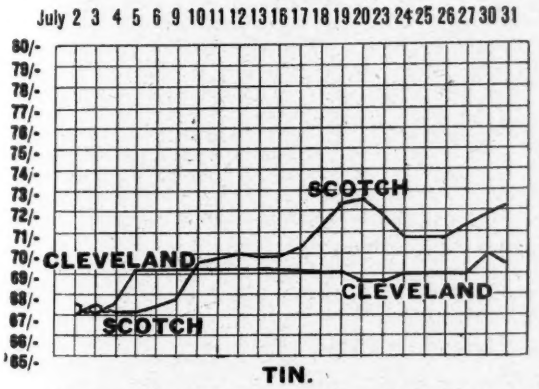
METAL MARKET.—Fluctuations in July.



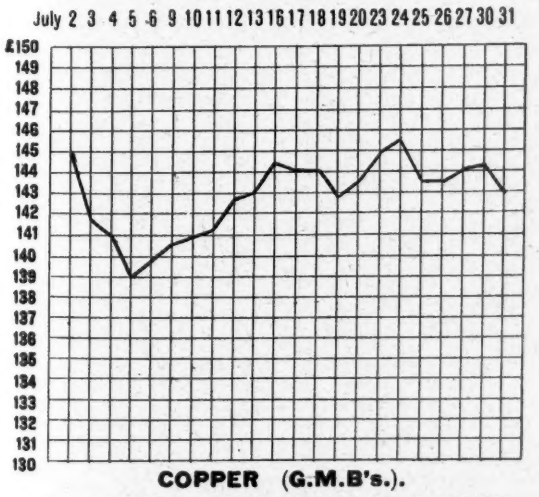
LEAD (ENGLISH).



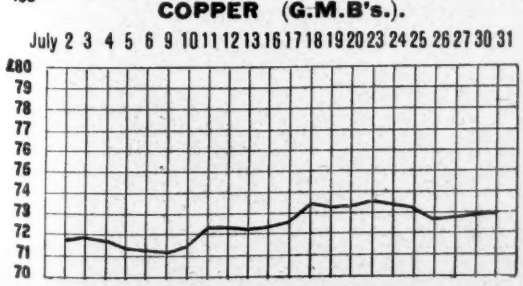
IRON.



TIN.



COPPER (G.M.B's.).



PHYSICAL SOCIETY.

Ordinary Meeting held June 8th, 1900.

Dr. J. H. Gladstone, F.R.S., Vice-President, in the chair.

A Paper on "The Magnetic Properties of Alloys of Iron and Aluminium. Part II." By S. W. Richardson and L. Lownds, was read by Dr. Richardson.

Experiments have been made to ascertain in what way the hysteresis loss between given limits of the field strength is connected with the temperature for an alloy containing 3·64 per cent. of aluminium. The experiments show that the hysteresis loss attains a maximum value at a temperature considerably higher than the temperature of maximum induction. The changes produced in the magnetic properties of the alloy by heating and subsequent cooling have also been investigated. The properties depend largely on the previous history of the specimen, but there does not appear to be any essential difference between the behaviour of the alloy during heating or cooling (except near the temperature of minimum permeability). Experiments have also been conducted on the abrupt change in the permeability that takes place at a temperature of about 650° C. The conclusions arrived at are as follows:—1. The hysteresis loss at first diminishes as the temperature rises. It then increases and reaches a maximum at about 550° C. On further heating it falls off rapidly, and is negligible at 700° C. 2. The magnetic properties of the specimen depend largely on its previous history. 3. There is no essential difference between the behaviour during heating and cooling except near the temperature of minimum permeability. 4. An abrupt increase in the permeability takes place at about 650° C. during heating, followed by an equally abrupt diminution on further heating. 5. This abrupt change is more marked with falling than with rising temperatures. 6. Continued heating and cooling diminish the permeability. 7. The curve connecting temperature of minimum permeability and percentage aluminium is a straight line. 8. The microscopic examination of the specimens shows the presence of crystals.

Prof. S. P. Thompson asked if the specimens had been kept for any length of time at a high temperature, because crystals changed and grew in metals at temperatures even far below their melting points.

Prof. Reinold asked if any specimens had been examined where the crystalline structure had not been observed.

Mr. Blakesley asked if any explanation of the orientation of the crystals could be given.

The Chairman said it was difficult to know exactly what substances were being dealt with. They might be pure alloys or mixtures of two or three alloys with iron or aluminium.

Dr. Richardson, in reply, said the crystals might be dissolved in nitric acid and analysed, but at present he did not know their composition.

Mr. W. Campbell then read a "Note on Crystallisation Produced in Solid Metal by Pressure," and a paper on "The Viscosities of Mixtures of Liquids and Solutions" was read by Dr. C. H. Lees.

The Secretary read a note from Prof. Wood on "An Application of the Method of Striæ to the Illumination of Objects under the Microscope."

The meeting then adjourned until June 22nd.

Ordinary Meeting held June 22nd, 1900.

Mr. T. H. Blakesley, Vice-President, in the chair.

A paper entitled "Notes on Gas Thermometry," by Dr. P. Chappuis, was read by Dr. Hasker.

A paper on "A Comparison of Impure Platinum Thermometers," by Mr. H. M. Tory, was read by Prof. Callendar. The object of this paper is to investigate the probable order of accuracy attainable in the determination of high temperatures by the use of ordinary commercial specimens of platinum wire.

A paper on "The Law of Cailletet and Mathias, and the Critical Density," was read by Prof. S. Young.

The Society then adjourned until next October.

THE MUNICIPAL ELECTRICAL ASSOCIATION, 1900.

THE PROTECTION OF TELEGRAPH AND TELEPHONE WIRES IN CONNECTION WITH OVERHEAD TRACTION.

By R. C. Quin, Borough Electrical and Tramway Engineer, Blackpool.

(Paper read June 22nd.—Abstract.)

This question is of special importance in view of the number of traction systems now being installed.

That overhead telegraph and telephone wires need protection will be admitted, but how shall this protection be best given? To the author the best method appears to be the placing of these telegraph and telephone wires underground where they cross the line of tramway route. He believes the telephone company are not averse to this course being adopted; but we are met with the absolute refusal of the Post Office to consider any such proposition.

The most usual practice until a comparatively recent date

was to place guard wires above the overhead trolley line at a distance of about 18 inches, these wires being of galvanised steel and supported by insulators. What are the insulators intended for? Are they to protect the telegraph or telephone wires or the trolley line?

Assuming that we adopt guard wires, they should be supported on poles 2 feet above the trolley line, but they should not be insulated. If a telegraph or telephone wire break, what need is there to insulate from earth? If two guard wires in the same horizontal plane and 18 inches apart be placed over the trolley line, the probability is that the broken telegraph or telephone wire would not come in contact with the trolley line or passing trolley; but it might do so. In that event it is better that the guard wire should be efficiently connected to earth, as a short circuit would be the result, and if both lines, telegraph and telephone, and trolley line be properly protected by maximum current apparatus no damage would ensue. The author would, however, point out that it is not sufficient to have these guard wires clamped to a traction post when the traction post is bedded in concrete. There should in all cases of guard wires be two poles bonded to the rails, and these poles should preferably be the end ones of the guard wire section. The telephone and telegraph wires should be provided with fusible cut-outs or other similar device for the protection of the terminal instruments, and this is a matter of no great cost. With these precautions there need be no fear of electrical accidents from overhead telegraph and telephone wires.

There is another system of protection now largely adopted and which consists of fastening to the trolley line brass clips, and placing vertically over the trolley line a wooden moulding of greater width than the trolley wire. It is more unsightly than the guard wires, and brings the trolley line into greater prominence. There also appears to be difficulty in thoroughly securing these strips, for in most towns in which they are in use many lengths have become detached. Further they do not afford the same protection as guard wires. A telephone wire may break and fall on the strip, but so far no great damage results. A car however comes along, and as has happened the driver does not notice the fallen wire, but the cheeks of his trolley wheel touch the wire, forming contact between it and the trolley line. We then have a live telephone wire earthed only through its terminal instruments, and a live dangling wire on the car, which is not assuring to the passengers.

There is a third method which is advocated by the Post Office, and that is a system of bunching telegraph wires so as to reduce the number of crossing places, and then forming an insulated cradle or hammock round these wires. The principal objection to this course would be extreme unsightliness. It, moreover, by no means follows that if a wire breaks it will not fall through the cradle, as the meshes are 2 to 3 feet square.

If we are to regard as impossible the laying underground at crossing places of telegraph and telephone wires, then the author suggests the following as the best method to protect telegraph and telephone wires.

1. The erection of two guard wires 18 inches apart, at a minimum height of 2 feet above the trolley line.

2. The length of the guard wires to be such that, should the crossing telegraph or telephone wire break close up to one span insulator, and be blown horizontally in either direction, it could not, when falling, come in contact with an unguarded portion of the line.

3. Each span of guard wires should be separate and distinct from its neighbour, but metallically looped across.

4. No insulators whatever should be used, but guard wire standards be bolted direct to the bracket arms, or to the span wire as the case may be.

5. The terminal posts of each length of guard wire should be bonded to the tram lines.

6. The trolley line should be divided into sections, and each protected by a maximum current device. These sections should preferably not be of equal length, but proportioned for equal maximum working current.

7. The crossing span of telegraph or telephone wires should be terminated by a disconnecting insulating shackle on each side and the connection across these shackles should be by fusible metal bridge.

If these suggestions be carried out, the author considers that all that is humanly possible to protect overhead telegraph and telephone wires will have been done.

INSTITUTION OF ELECTRICAL ENGINEERS.

ALTERNATING CURRENT INDUCTION MOTORS.

By A. C. Eborall, Associate.

(*Paper read May 17th*, 1900.)

(*Continued from page* 203.)

With the exception of the Heyland motor, all the devices employed for producing this requisite phase difference are external to the motor, and they have all been devised at one time or another by Mr. C. E. L. Brown, and have gradually been adopted by all other single-phase motor builders. These external starting devices take the special form of arranging that the self-induction of the circuit including the starting coils has a much higher value than that of the circuit containing the running coils, this being attained by suitable winding proportions in conjunction with choking coils or non-inductive resistances, or condensers; or any two of these in one or other of the stator circuits. The choice of such apparatus is governed by the relative value of the turns in the starting and running coils, and by the particular connections used at starting.

The starting torque given by motors arranged in this way is inconsiderable, barely sufficient in fact to run the motor up to speed against the load of belt and loose pulley. Moreover, unless the motor is very carefully designed—particularly from the magnetic

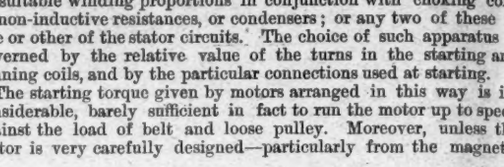


Fig. 7.

leakage point of view—the starting current at this small torque will be excessive. With the above-named exception, the very best single-phase induction motors of the present day working under the most favourable conditions require a current at starting at least equal to the full-load current in order to run them up to speed without the load, while against the full load they will not start at all, whatever the value of the starting current.

The principal reasons for these comparatively indifferent results are, that the phase difference at starting produced by the above-mentioned means is small, and that the cross-flux produced by the starting coils does not attain a high value. As with independent alternating-current circuits a large phase difference will be produced by increasing the self-induction of the circuit, it might be thought that this could also be obtained in a motor by arranging the starting

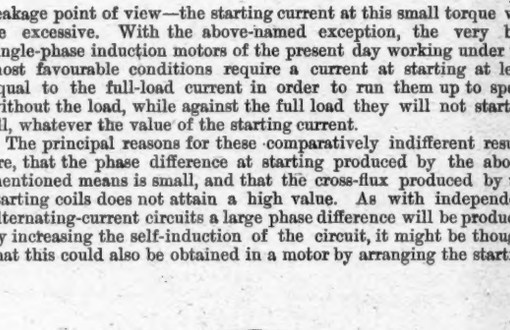


Fig. 8.

device and starting coils on these lines. But it must be remembered that the stator circuits of an induction motor are not really independent, on account of the action of the rotor currents. These behave with regard to the stator currents just as the loaded secondary of a transformer behaves with regard to the primary—that is to say, the self-induction of the stator windings is more or less completely wiped out by the mutual induction of rotor and stator. It follows from this that better results will be obtained if the number of turns of the starting coils is kept low, and the increase of self-induction produced by an external choking coil, or equivalent device involving magnetic leakage. This point was recognised at an early stage by motor builders, and an external choking coil (to produce as much phase

difference as possible) is a leading feature of several modern starting devices.

But this increase of self-induction, whether produced externally in this way, or by winding the starting coils with a large number of turns, effectually prevents the starting field of the motor (that is, the field in quadrature position to that of the stator running coils) from attaining that high value already shown to be absolutely necessary if a large starting torque is required. Where the self-induction is increased by increasing the turns of the starting coils, the strength of the cross-flux falls off inversely as the square root of the self-induction; if the choking coil is used, the strength of the cross-flux is diminished by an amount equivalent to the leakage flux of the coil. Consequently, it is evidently a clear fundamental point, that to obtain a large starting torque the self-induction of the starting coils should be kept down as much as possible.

It has been hitherto generally held that the design of starting devices for single-phase induction motors should be such that the starting conditions should approximate as nearly as possible to the starting conditions of polyphase motors—that is, designers have aimed at the production of a rotary field at starting. Not only this, but every effort has been made to make this field as uniform as possible, by so proportioning the windings of starting and running coils as to produce two equal magnetic fluxes, and the production of a larger field by one or the other winding has been particularly avoided.

Mr. Heyland's motor, which is shown here to-night, and described below, is designed with regard to the starting device on exactly opposite lines to these. Briefly, there is no external phase-shifting device, the starting winding being put straight on the mains, and this winding has comparatively few turns, and is so arranged that under all circumstances its self-induction is less than that of the running coils—that is, the winding carrying the current of greater phase difference is made to have the smaller self-induction. As a result of the small self-induction of the starting coils, a cross-magnetic flux of great strength is available, and this cross-flux is made to have the proper time relation by a special arrangement of the magnetic circuit of the stator. The production of a rotary field at starting is not aimed at, the whole idea of the starting device being to produce a powerful alternating magnetisation having the proper phase relation, in a direction (considering the two-pole case) at right angles to the axis of the running coils. The result is that the Heyland single-phase motors will all start against full load, quite easily, without an excessive current consumption, and it will be therefore readily admitted that an important advance has been made in single-phase motor work.

Apart from the design and arrangement of the starting device, the Heyland motors differ but little from other well-designed motors of the induction type. The stator running winding consists of a number of rectangular coils wound in half-closed slots in such a manner that magnetic leakage is as small as possible, while the rotor is wound with a regular three-phase star-connected winding, with its three free ends connected to slip-rings on the shaft, for the insertion of a starting resistance. A squirrel-cage rotor, or one of its modifications, could be easily used, but it has been found that the reduction of the starting current (for a given torque) brought about by the use of the resistance well repays its use, even for motors as small as 1 H.P.

Fig. 7 illustrates diagrammatically the stator windings of the Heyland single-phase motors, the figure illustrating a four-pole motor. The running coils are shown by the full lines, and the starting coils by the dotted lines. These latter coils are wound in rectangular holes in order to obtain the necessary large phase difference of the current in them; the flux produced by these coils links very unfavourably with the rotor windings, which has the effect of reducing the mutual induction of the circuits in question, with the result that the current in the starting winding lags considerably, sometimes as much as 50°. The relation of the stator starting coils to the coils of the rotor, is, in fact, entirely analogous to the relations existing between the primary and secondary coils of a transformer having great magnetic leakage.

As stated above, the turns of the starting coils are comparatively few in number, and have a low resistance; the amount of phase difference of the flux produced by the current in them is determined by the shape given to the holes, the dimensions of these, and by the winding depth.

Figs. 8 and 9 show clearly the arrangement of the stator running and starting coils as actually carried out for a four-pole motor, while the form of the rotor winding can be seen from the latter figure also.

The motor is started as follows:—All the rotor resistance being in circuit, the stator windings (both running and starting) are switched directly on the mains; the motor will immediately start up with great torque, and the rotor resistance and starting coils are to be cut out as it does so. The exact moment at which the latter are cut out affects only the starting current; if the motor is starting light, the single-pole switch can be opened when the arms of the rotor resistance are on the second contact; if it is starting against full load, the starting coils require to be left somewhat longer in circuit—that is, they are to be cut out, for instance, on the fourth or fifth contact of the starting resistance.

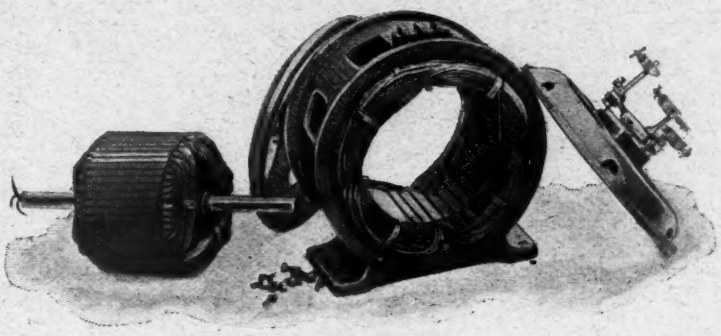


Fig. 9.

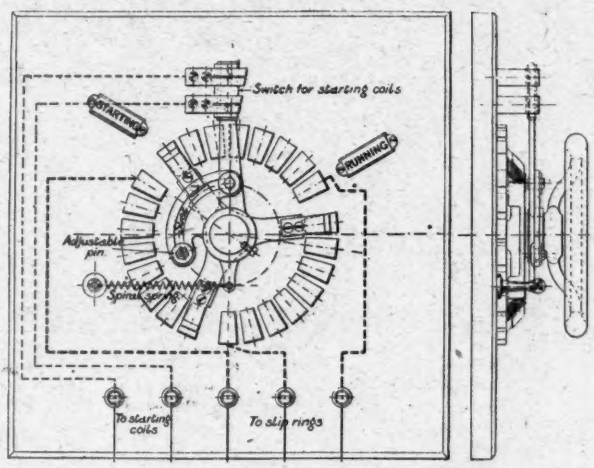


Fig. 10.

The earlier Heyland motors were all furnished for use with a single-pole switch in the starting circuit. This has now been done away with, however, by combining it with the starting resistance box (see fig. 10), so that the operation of starting up is as simple as that with a shunt wound direct current motor.

(*To be concluded.*)

OUR LEGAL QUERY COLUMN.

[*Questions addressed to the Editors for insertion in this column should be as brief and concise as possible. Free use of fictitious names, &c., may be made. Answers are furnished by a duly qualified lawyer, but the Editors cannot undertake to be responsible for the accuracy of the views which he may express.*]

Private Consumer writes: "I shall be glad to have your opinion on the following legal point. The wires and fittings in my house were put in by the electric supply company for this district. For some time everything went well, until last week all the lamps in one room went out. I employed a local 'electrical engineer' to effect repairs. While at this work he caused a short circuit, which has done considerable damage and has involved me in great expense. The local man alleges that the short circuit was due to the faulty laying of wires in the first instance. From whom can I recover the cost?"

*** If it can be proved to the satisfaction of the Court that the accident and the entire damage was due to the faulty laying of wires by the supply company in the first instance, the company, if they were under obligation to supply a proper wire, are clearly responsible, and can be sued for the cost. As our correspondent is doubtless aware, electric supply companies are answerable for all damages happening through the act or default of themselves or their servants. [See Section 77 of the Schedule to the Electric Lighting (Clauses) Act, 1899.] Thus in Burrows *v.* the March Gas Company [L. R., 7 ex 96,] the defendants, a gas company, contracted to supply the plaintiff with a proper service pipe to convey

gas from the main outside to a meter inside his premises. Gas escaped from the pipe laid down under the contract into the plaintiff's shop.

The servant of a gas-fitter employed by the plaintiff happened to be at work in another room at the time of the escape, and went into the shop upon hearing of it to find out the cause. He was carrying a lighted candle in his hand, and immediately on entering the shop an explosion took place, doing damage to the plaintiff's stock and premises. On the trial of an action against the defendants for their breach of contract in not supplying a proper service pipe, the jury found—(*a*) That the escape of gas was occasioned by a defect in the pipe, and that the defect existed in the pipe when supplied; (*b*) that there was negligence on the part of the gas-fitter's servant in carrying a lighted candle. It was decided by Wills, Blackburn, Mellor, Brett and Grove, J. J. (affirming the judgment of the Court below), that the plaintiff was entitled to recover, and that the defendants were not relieved of liability by the negligent act of the gas-fitter's servants.

In the course of his judgment Cockburn, C. J., said:—"The defendants ought to have taken care, before laying gas on, that the apparatus of which this pipe was a part was safe and sufficient. They have thus been guilty of a double default—first, in supplying a defective pipe; and, secondly, in sending gas through it in quantities calculated to produce the catastrophe which occurred. The escaped gas was the direct consequence of their breach of contract, and was necessarily dangerous." Seeing that our correspondent will probably have some difficulty in proving that the wires were improperly laid in the first instance, we are of opinion that his more prudent course would be to sue the fitter. There is authority for saying that undertakers cannot be held responsible for accidents which occur when fittings properly constructed by them are being altered or repaired by a fitter employed by the consumer. Under such circumstances the fitter is liable. So in Parry *v.* Smith (1879, 4 C. P. D.) the defendant, a gas fitter, was employed by the plaintiff's master to repair a gas meter upon his premises, and for the purpose of doing so took away the meter. In lieu thereof he made a temporary connection by means of a flexible tube between the inlet pipe and the pipe communicating with the house. The plaintiff having gone in the ordinary performance of his duty with a light into the cellar where the meter had been, gas which had escaped by reason of the insufficiency of the connecting tube exploded and injured him. The jury found that the work was negligently done. It was decided that the defendant was liable.

In the course of his judgment, Lopes, J., said:—"I think the plaintiff's right of action is founded on a duty which I believe attaches in every case where a person is using, or is dealing with, a highly dangerous thing which, unless managed with the greatest care, is calculated to cause injury to bystanders. To support such a right of action, there need be no privity between the party injured and him by whose breach of duty the injury is caused, nor any fraud, misrepresentation, or concealment; nor need what is done by the defendant amount to a public nuisance. It is a misfeasance independent of contract."

THE BERMONDSEY ELECTRIC LIGHTING CABLE CONTRACT.

As little information is generally available respecting the reports of consulting engineers on large contracts for electric lighting cables, considerable interest will doubtless be manifested in the comments made by Messrs. Kincaid, Waller & Manville on the tenders recently submitted for the mains and ducts required by the Vestry of Bermondsey. It may be remembered that the following firms tendered for the contract:—

1. St. Helens Cable Company	£8,109	16	8
2. Siemens Bros. & Co.	8,113	9	11
3. W. T. Glover & Co.	8,134	7	9
4. Callender's Cable Company	8,212	7	1
5. Western Electric Company	8,719	11	11
6. British Insulated Wire Company	8,643	15	10
Engineer's estimate	8,190	0	0

The tender of Messrs. Glover & Co. has been accepted. The comments of the consulting engineers, as contained in a report submitted to the Vestry, are as follows:—

1. The lowest tender is the St. Helens Cable Companys, quoting £8,109 16s. 8d. In their tender of this amount they quote for cables insulated with paper and lead covered, which complies with the requisitions of the specification. They send an alternative quotation at £8,053 16s. 8d. for cables covered with paper and then rendered waterproof with vulcanised bitumen, without any lead sheathing. This method, however, is not in accordance with the specification, and, indeed, in the present absence of experience of the longevity of cables made in this manner, is not a method which we recommend for your consideration. The company is comparatively a new one in the manufacture of electric mains for electricity supply station purposes, and they, in fact, only mention one place where cables of the character of those of their higher tender—which conforms to the specification—are being at present laid by them, *i.e.*, Wrexham; and having regard to the very small difference in price between their price and that of some of the other cable makers who have very extensive experiences in the same direction, you may think it desirable not to place the order with them.

2. The next highest tender is that of Messrs. Siemens Bros. at £8,113 9s. 11d. This firm is a well-known one as a manufacturer of electrical cables for purposes such as you have in view. The specification and samples of the mains they propose to supply are in order, but they take three exceptions to the general clauses in the specification, two of which you will, no doubt, consider of great importance. The first of these two important ones is that they take exception to the wages clauses as follows:—"We are also sorry to state that we could not see our way to subscribe to any general clause regulating the wages to be paid by us for any particular work." You will recollect that you have specially had inserted in the specification a stringent wages clause, regulating the rate of wages and time on the various parts of the work; and as the non-observance of these conditions might materially affect the cost of the goods supplied, we think you will hardly consider the tender of this firm in competition with others who do subscribe to the wages clause.

The second objection they make is to the schedule of prices, which provides that during 12 months from the time of the receipt of the order for the present work the contractors are to hold themselves liable to supply further material for the extensions at the scheduled rates included in their tender. Messrs. Siemens Bros. state that they cannot undertake to do this, but must be paid for further work at the market rates, *i.e.*, that they should be paid at a higher rate than the schedule should prices go up and a lower rate than the scheduled prices should they go down. And seeing that your vestry are only committed under this contract to order further supplies under the schedule at the vestry's option, and not at the contractor's option this would be no advantage to you, since in any case you would not order at these scheduled rates should prices go down, whilst under the contract you would order should prices remain the same or advance during the year; and this modification of theirs is an important one, seeing that it is extremely likely that you will continue to extend the mains beyond the quantity provided for in the specification. The third objection they take, which is not of so much importance, is in regard to a clause in the general conditions, in which contractors are made responsible for accidents which may happen until the works are taken over by the vestry; and Messrs. Siemens Bros. state that they can only agree to this so far as it concerns acts of their own staff. This does not appear to us to be nearly so serious an exception to the specification as are the other two above referred to.

3. The next highest tender is that of Messrs. W. T. Glover & Co., at £8,134 7s. 9d. Messrs. Glover & Co. also tendered £8,018 conditionally upon their supplying wooden troughing for the solid filling in system for the distributing cables in place of earthenware troughing, owing to their doubts as to their ability to obtain earthenware troughing in the time specified. They have, however, since stated that they will be able to do this, and the extra cost of the earthenware troughing as against the wooden troughing brings their price up to £8,134 7s. 9d., as stated above. They make no exceptions to any of the conditions in the specification, and their tender in that respect is therefore quite in order. This firm have had a large experience in the carrying out of works similar to those which you now require, and have actually carried out some under our supervision for the Corporations of Portsmouth and Southampton and the Vestry of Shoreditch, in each of which jobs they have given complete satisfaction.

4. The next highest tender is that of Messrs. Callender and Co., at £8,212 7s. 1d. This firm, like Messrs. Glover & Co., have had a very large experience in work of this class. Their tender is in order, with one exception, as follows:—It is provided in the specification that the contractors guarantee the mains they lay against all defects, except those due to mechanical injury beyond their control, for a period of five years from the date of their being set to work. Messrs. Callender & Co. state they can only enter into this guarantee assuming that no cable is loaded to a greater current density than 1,000 amperes per square inch section, or at a greater working pressure than 600 volts for an extended period. This, of course, is very vague. It is certain that when any accident [happens] in the way of a short circuit on the consumer's premises or otherwise, the cables will be loaded to a greater density than 1,000 amperes per square inch section, and the question will arise under their guarantee, should there afterwards be a dispute, as to what is meant by "an extended period," and we think it is an undesirable condition to attach to the guarantee, especially seeing that other contractors do not do so.

5 and 6. The other tenders being still higher than those commented upon, you will probably not care to consider them.

REFUSE DESTRUCTION AT TORQUAY.

The report of the proceedings at the Plymouth meeting of the Institution of Mechanical Engineers which was issued not long ago contains a paper by Mr. Henry A. Garrett, borough engineer and surveyor at Torquay, entitled "Refuse Disposal and the Results Obtained from a Six Months' Working of the Refuse Destructor at Torquay." From this title one would be led to expect statements and figures of great value to everyone interested in the subject of refuse destruction, inasmuch as no detailed results relating to anything like so long a period as six months' working of a refuse destructor have as yet been published. The paper, however, does not fulfil the promise of its title. Figures relating to four tests are given, but it comes quite as a moral shock that the durations of these tests are respectively 12 hours, 3½ hours, 3 hours, and 3 hours. It is difficult to see how the author reconciles these homœopathic trials with his own statement in the opening paragraphs of his paper, that "care must be exercised not to place too much

reliance upon evaporative or combustion results obtained by one or two tests."

In No. 1 test (December 21st, 1898), 8.30 a.m. to 8.30 p.m., the total weight of refuse delivered to destructor during the day is put at 19 tons 7 cwt. The total weight of refuse burned during the 12 hours is stated to have been 16 tons 7 cwt. Here, again, one is left quite in the dark as to how this was measured, in what quantities it was fed in, what was the percentage of moisture, what steps were taken to ascertain the condition of the fire at the commencement and at the end of the test, and other details of a more or less important character. Although the test is reported to have commenced at 8.30, the total quantity of water evaporated appears to be calculated from "8 a.m. from a cold water feed and steam gauge standing at 00." The next paragraph gives the refuse burned per pound of water evaporated under disadvantageous circumstances above referred to. We admit the circumstances to have been disadvantageous. The average steam pressure maintained in each boiler is stated to have been 57 lbs. (presumably per square inch), the highest reading being 105 lbs. per square inch and the lowest 38 lbs. per square inch. The total I.H.P. developed is then arrived at by dividing the total quantity of water evaporated by 20. There can be no question about the fascinating simplicity of this method of calculating the indicated horse-power developed for the water evaporated, but it is not justifiable, even when dealing with so democratic a fuel as "muck," to entirely ignore the influence of steam pressure upon the water per I.H.P.-hour.

In tests Nos. 2 and 3 (3½ hours and 3 hours) the amount of refuse burnt during the test is recorded with the greatest accuracy. The amount burned is 3 tons 6 cwt. 2 qrs. 24 lbs. Having regard to the weight of refuse on the grate, it would be interesting to learn what means were adopted to determine the amount consumed in 3½ hours to *one pound*.

The average steam pressure in this test is stated to be 54 lbs. (per square inch), but the reader has no means of judging if this is a fair average or otherwise, as the readings from which the average is deduced are not given. In this trial a vertical engine is stated to have been running a mortar with *exhaust open* (the italics are not ours). It seems unnecessary to record the fact that the exhaust was open, as the engine might otherwise have struggled ineffectually with the mortar mill.

In comparing the results of the four tests, the author states that it is interesting to note that although the refuse was of such a variable nature the power developed on each occasion was practically the same. With this we agree.

The author touched upon one very important point, namely, the cost of working and burning the refuse. There can be no doubt that the great disparities in the reported costs at different towns are in a great measure due to the want of some standard method of compiling the cost. In our judgment the cost should include:—

Wages of stokers.
Salaries of superintendents and clerks.
Wages of labourers or others handling the refuse on arrival.
Interest on capital expenditure.
Rates, taxes, gas, water, oil and waste, and sundry stores.
Depreciation on plant and machinery.
Sinking fund for redemption of capital and interest at the end of a given period of years.
Any extra costs, such as carting away ashes, dust, &c., repairs, fuel (if any necessary) to burn with refuse.

The author does not go far enough in the matter of costs; he only includes the wages of the men engaged, and an allowance for superintendence. This latter, however, he omits in test 4, because the revenue from the mortar sold covers it. We do not think that the matter should be dealt with in this way; the expenses and the revenue ought to be set out separately.

It would seem that the time is ripe for another such report as was undertaken at the instance of the Local Government Board in 1888. With towns rapidly extending, and population as rapidly increasing, the sanitary disposal of refuse becomes daily of greater importance, and the need of reliable statistics more accentuated. It is a matter that one of our great engineering Institutions should take up. We admit that the work would be arduous and disagreeable, but so far engineers have never put their own feelings in the way of progress in their profession, and we feel sure that there would be no difficulty in finding competent and reliable men, experienced in experimental work, who would be ready to undertake the tests.

THE ELECTRIC LIGHTING AND TRAMWAYS OF BUENOS AIRES.

(*Continued from page* 96.)

In the new station there is a 500-KW. motor-generator set for either traction or lighting, it being primarily intended for the former. This set is made up of a 16-pole 530-KW. synchronous motor (with direct coupled exciter), direct coupled to a 500-KW. multipolar 500-volt dynamo, running at 375 r.p.m.; the motor takes its current direct from the 3,400-volt bus bars without transformation.

There is a small motor-driven workshop with lathe, drilling press, &c., for the general repairs of the station. A new building is now constructed, which contains stores for heavy material, transformer and meter repair shop, also dining room and lavatories for the men.

The company have on order two double tandem compound engines. On the shaft of each engine there will be one 1,000-KW. monocyclic alternator, and one 1,000-KW. 500-volt tramway generator. The capacity of each engine will be that of one generator (either monocyclic or tramway) fully loaded, say, 1,000 KW., but not both at once.

The necessary boilers, condensers, &c., have also been ordered.

The distribution is effected by means of triple cored cables, lead sheathed and steel armoured, for both primaries and secondaries. All the cables are supplied by Messrs. Felten and Guilleaume, and laid by their engineer, Mr. F. Klostermann, in a manner reflecting great credit on the firm. There are seven feeders going to the most important distributing points: these again are so interconnected that any one of the feeders can be cut out for testing or any other purpose. From these centres, which are the transformer sub-stations carrying the heaviest load, small distributing primary cables radiate to the other sub-stations.

The heaviest feeder has two cores of 170 sq. mm., and one core of 60 sq. mm. The heaviest primary cable has two cores of 50 sq. mm., and one core of 16 sq. mm. The heaviest secondary cable has three cores of 95 sq. mm.

For the regulation of the voltage the station is connected with 13 points in the secondary network by means of pilot wires. Any one of these can be connected to a Thomson multi-cellular electrostatic voltmeter, so that if the voltage is low during the period of heavy load, it can at once be raised on the primary feeder corresponding to that section by means of a regulating booster transformer.

The cables are in all cases laid under the pavement. This was by no means an easy matter, as the pavements are seldom more than 5 feet wide, and already underneath them lay the cables of three other electricity companies, the pipes of three gas companies, and water pipes. The cables were laid directly in a trench whose bottom was first covered with dry sand, then a second layer of sand covered the cables completely. This facilitates the drainage of moisture from around the cables. Lastly, over all common stock bricks were laid, to warn subsequent excavators. Only at street crossings were the cables laid in cast-iron pipes; now, however, a new municipal law requires all primaries to be laid in pipes.

In all 200 kilometres (125 miles) have been laid, a large part of this work having been done at night, as inside a certain perimeter the municipality will not allow the streets to be opened by day.

As the four electric supply companies in Buenos Aires have no distinct sections of the city allotted to them, but are allowed free access to all parts, it was necessary to lay cable over a very large area in order to obtain customers.

There are 50 transformer sub-stations scattered over all the area supplied by the Cia. General; they are of uniform size, and have room for four 30-KW. transformers each.

These sub-stations are all constructed under the street, being entered through water-tight manholes flush either with the pavement, or in some cases with the roadway itself; in the latter case the iron manhole door is protected by a hard wood cover 4 inches thick so as to withstand the heavy traffic. Here, again, almost insuperable difficulties were met with in the shape of drains, gas, and water pipes; some of the gas companies had no plans whatever of the pipes laid when they first commenced operations, consequently they were often met in most unexpected places. Thus it is not surprising to know that a large percentage of the gas generated at the works of some of the gas companies is lost by leakages, so that in parts the subsoil is saturated with gas. In one case in order to escape the pipes it was necessary to go a depth of 4 m. before the excavation could be commenced, and even then the entrance had to be inclined 15° out of the perpendicular.

The excavation was first lined with a wall of single bricks laid on edge, this was then covered with a heavy coat of hot asphalte, and the inner wall built in the usual way. The principal dimensions are 3·5 m. high and 2·5 m. long by 2 m. wide. The lower part to a height of 1·5 m. is occupied by the transformers, these being covered by a removable floor in sections. Above this comes the switch gear, the high tension being on one side and the low tension

on the other. For ventilation there are two 12-inch pipes, one rising from the bottom of the chamber and the other from the top; these terminate in two iron gratings in the wall of the house alongside. The upcast pipe has a small electric fan placed in its mouth in order to increase the circulation of air during the very hot summer months. The primary feeder supplies the bars of three boards on the same side, there being a switch fuse for each pole (+, − and teaser) one above the other, whilst three other boards carry the fuses for the four transformers. As an accurate guide for cutting in and out transformers in order to avoid day load losses as much as possible, a recording ammeter of the hot wire pattern is placed between the transformer low pressure board and the secondary distributor board. The transformers were built by the Union Company after the usual General Electric pattern. In addition to the foregoing, there are also 17 heavy consumers who have transformers installed on their premises.

The secondary network is divided up into sections, which are usually fed independently, but are capable of being interconnected by means of switch fuses in the sub-stations. The fuse boxes were made by Felten & Guilleaumé, and are of two sizes, for four and six cables; they are extremely roomy, and offer great facilities for the replacing of fuses, being in this respect in marked contrast to the cramped types adopted in many parts. There are more than 760 in use. The number may appear large, but as the city is laid out in squares of approximately 100 m. by 100 m., it was the only method possible, and they are a very great convenience in every way.

Thomson meters are used exclusively on the consumers' premises, and the price per unit varies according to the following tariff :—

TARIFF.

For comparison only, the Argentine gold dollar may be taken as equivalent to the U.S. dollar; actually it is worth a little less (96·5 cents U.S. = 1 Argentine gold dollar). The price per unit of energy for lighting purposes is 25 cents. On this price the following discounts are allowed :—

5	per cent.	if the monthly consumption exceeds		25	units.
10	,,	,,	,,	50	,,
15	,,	,,	,,	100	,,
20	,,	,,	,,	200	,,

An additional discount is given at the end of the year as follows :—

				Per lamp installed.	
5	%	if the annual consumption exceeds an average of		500	hours
7·5	,,	,,	,,	750	,,
10	,,	,,	,,	1,000	,,
12·5	,,	,,	,,	1,250	,,
15	,,	,,	,,	1,500	,,
20	,,	,,	,,	2,000	,,

The average of the hours of consumption is calculated by dividing the total units per annum by the KW. installed. The price for power up to 1,500 units per month is 12·5 cents for the first 50 units, and then 7·5 cents per unit. Above 1,500 units by special arrangement. Power for fans 12·5 cents per unit for any consumption.

There are at present installed 50,000 16-C.P. lamps and 300 H.P. in induction motors; these latter range from ½ H.P. to 20 H.P., and give great satisfaction. Some of the larger sizes are installed in flour mills and run day and night, only shutting down on Sundays. Where the teaser cable does not pass the door, single-phase motors of the Wagner type are adopted. Seven theatres, including the Grand Opera House, take their current from the company's mains.

Municipal lighting to the extent of 350 arc lamps is furnished by the company. In the narrow streets, two 1-inch gas pipes are attached to rosettes on the walls of opposite houses, the two pipes being united in the centre of the street by a cast-brass globe from which is suspended the lamp; in the Boulevard Callao and Avenida Alvear cast-iron columns are employed. The bareness of the pipes and globe is relieved by wrought-iron scrolls, the whole forming a very neat method of suspension. The arc lamps are all of the General Electric open arc focussing type, and are fed from small transformers placed on the walls of the houses or in the bases of the columns. The transformer ratio is 230 to 33, and the lamps take 15 amperes. They are suspended at a height of 7·5 m. and are spaced 50 m. apart, one at the street crossings, and one in the middle of the block. Enclosed arcs were tried, but were found unsuitable for street lighting; they have been very largely adopted for shop lighting, both windows and interiors, with marked success.

A very large measure of the company's success is due to the popularity of its indefatigable chief engineer and manager, Count Charles Chicogna. Probably in no city in the world is the population so cosmopolitan as in Buenos Aires, and great tact is needed in dealing with its members; a thorough knowledge of every European language of importance, such as Count Charles Chicogna possesses, is of inestimable value in such a position.

Too much praise cannot be given to the Union Electricitäts Gesellschaft, and their highly capable engineer, Mr. W. S. Hulse (who is a specialist in alternate current working), for the conscientious way in which the work has been carried out. On looking over the main features of the whole installation, it will be seen that every detail has been carefully thought out, due attention having been given to the abnormal conditions existing in Buenos Aires.

After assisting Mr. Hulse in the construction, Mr. J. T. Cornish, A.M.I.E.E., was appointed by the director to take full charge of the central station.

During the last six months Mr. Cornish has brought the coal consumption to a remarkably low figure; the average during the 24 hours does not exceed 4 lbs. per unit. The best Welsh coal is used, costing at the present time from 42s. to 50s. a ton delivered at the works.

The running expenses of the station, apart from the coal, are high, due (1) to the tramway plant being in a separate building, thus needing two staffs by day, when one would be sufficient were all under one roof, which will shortly be the case when the extensions are complete; (2) to the large staff of greasers and cleaners necessary for the type of engine employed; (3) to the high rate of wages paid in the Argentine Republic.

The peaks of the lighting and tramway loads occur at the same hour, viz., from 5 to 6 p.m., the maximum of the lighting being 425 amps. at 3,400 volts, and of the tramway, according to the watt meter, 600 kilowatts; the latter, however, was on a Sunday.

Nothing has been said about parallel running, but although many stations with direct coupled alternators have found it necessary to adopt various devices to effect this end, not the least difficulty has been experienced with this plant in synchronising the alternators, three 500-KW. machines being run in parallel every night until midnight, and no synchronising current is visible on the ammeters.

Mr. Fleming is in charge of the installation department, while Mr. Martinez de Hoz looks after all the outside work, such as cables, sub-stations, arc lamps, and meters.

(To be concluded.)

INDISPENSABLE ACCESSORIES OF ELECTRIC TRACTION.

By HENRY E. P. COTTRELL, A.M.I.C.E.

(Continued from Vol. 46, page 967.)

In the enamel rheostat delineated in figs. 104A and 104B (back and front view), the thin metal ribbon closely reflexed is attached edgewise by enamel to the cast-iron plate. The expansion or contraction of the metal ribbon through heating by the passage of heavy currents does not injure its perfect insulation from the plate, as the strains developed in the enamel are wholly compression strains, and do not tend to raise the enamel from the plate. The surface exposed to the air from which the heat can freely radiate is a maximum, and a considerable portion of the heat is also conducted to the heavy plate, and there partly absorbed and partly radiated with a minimum rise in temperature, on account of the mass of the plate being relatively very great, its specific heat high, and its radiating surface with the added ribs at the back very large. The ribbons are made of a special alloy, which, at the ordinary working temperatures, is not subject to oxidation or depreciation of any kind. Desiderata 3 and 6 are therefore completely fulfilled.

By this form of construction the size of the apparatus can be reduced by more than 15 per cent. as compared with forms where the coils are embedded, while the capacity of the rheostat can be increased by adding to any reasonable extent any number of plates one over the other, and connecting them so as to cut in any number in series as required. Desideratum

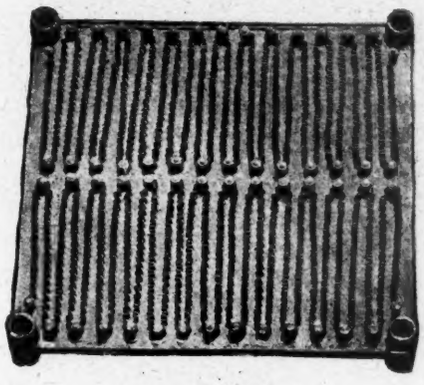


Fig. 104A.

4 is therefore complied with as to compactness, and it is also simple, as the three necessary elements—resistance wire, insulation, and radiating surface are all fused into one inte-

Fig. 4.

Fig. 104B.

gral mass. The subjoined table gives the dimensions and capacity of the standard resistance plates manufactured for use with these rheostats:—

Dimensions of plate in inches.	No. of sq. inches (one face only).	Continuous dissipating capacity. Watts.	Intermittent dissipating capacity (for 15 seconds only). Watts.	No. of steps.
4½ × 4½	20¼	100	400	1— 6
4½ × 4½	20¼	100	400	7—12
6½ × 6½	42¼	210	850	1— 8
6½ × 6½	42¼	210	850	9—16
8 × 8	64	320	1,280	1— 8
8 × 8	64	320	1,280	9—16
10 × 10	100	500	2,000	1—10
10 × 10	100	500	2,000	11—20
12 × 12	144	720	2,880	1—12
12 × 12	144	720	2,880	13—24
14 × 14	196	980	3,920	1—14
14 × 14	196	980	3,920	15—28
14 × 14	196	980	3,920	29—56
20 × 20	400	2,000	8,000	1—21
20 × 20	400	2,000	8,000	22—42

Two other forms of enamel insulated rheostats are manufactured by the Ward-Leonard Company. In the form known as the round field rheostat, figs. 105, the resistance ribbons run between parallel plates and are connected with and insulated therefrom at one and the same time by enamel, any required number of plates can be coupled in, as shown in the figure, so as to build up a rheostat of any required capacity. The switch in the face moved by a milled head enables the various steps into which the plates are divided by the ribbon connections, to be cut in or out at will, so that any desired resistance can be thrown into the circuit, either automatically by connection with the circuit or by the switchboard man.

The other form is shown on figs. 106, and known as the oblong field rheostat. Here the ribbons are attached to bars and not plates, otherwise the principles involved are identical. Both forms can be mounted either on the front or back of the switchboard.

The following tables (A and B) give the standard particulars of rheostats of the preceding forms for various voltages:—

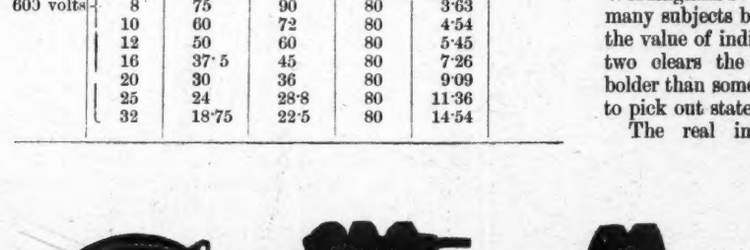
Table A.—Round Field Rheostats, for Front or Back of Board. Standard Sizes.

Limiting voltage.	Max. amp. 1st step.	Ohms of field to which rheostat is well suited.	Ohms of rheostat.	No. of steps.	Ampere capacity of last step.	Dia. in inches.
75	·5	150	180	24	·227	8
	·62	120	150	24	·284	8
	·75	100	120	24	·341	8
	1	75	90	24	·454	8
	1·25	60	72	24	·568	8
	1·5	50	60	24	·683	8
	2	37·5	45	24	·91	8
	2·5	30	36	24	1·13	8
	3	25	30	24	1·35	8
	4	18·7	22·5	24	1·82	8
	5	15	18	24	2·27	8
	6	12·5	15	24	2·7	8
	8	9·37	11·25	33	3·64	10
	10	7·5	9	44	4·5	12
	12·5	6	7·2	60	5·7	15
	16	4·7	5·7	60	7·3	15
	20	3·75	4·5	60	9·1	15
	25	3	3·5	60	11·36	15
125	·5	250	300	24	·227	8
	·62	200	240	24	·284	8
	·75	166	200	24	·341	8
	1	125	150	24	·454	8
	1·2	100	120	24	·568	8
	1·5	83	100	24	·683	8
	2	62·5	75	24	·91	8
	2·5	50	60	24	1·13	8
	3	42	50	24	1·35	8
	4	31	37·5	33	1·82	10
	5	25	30	44	2·27	12
	6	21	25	44	2·7	12
	8	15·6	18·75	60	3·64	15
	10	12·5	15	60	4·5	15
	12·5	10	12	60	5·7	15
	16	7·8	9·3	60	7·3	15
	20	6·2	7·5	60	9·1	15
	25	5	6	60	11·36	15
250	1	250	300	44	·454	12
	1·25	200	240	44	·568	12
	1·5	166	200	44	·682	12
	2	125	150	44	·909	12
	2·5	100	120	44	1·136	12
	3	83	100	44	1·366	12
	4	62	75	60	1·82	15
	5	50	60	60	2·27	15
	6·25	40	48	60	2·84	15
	8	31	37·5	60	3·65	15
	10	25	30	60	4·54	15
	12·5	20	24	60	5·7	15
500	1·25	400	480	44	·568	12
	1·5	333	400	44	·682	12
	2	250	300	60	·909	15
	2·5	200	240	60	1·14	15
	3	166	200	60	1·36	15
	4	125	150	60	1·82	15
	5	100	120	60	2·27	15
	6·25	80	96	60	2·84	15

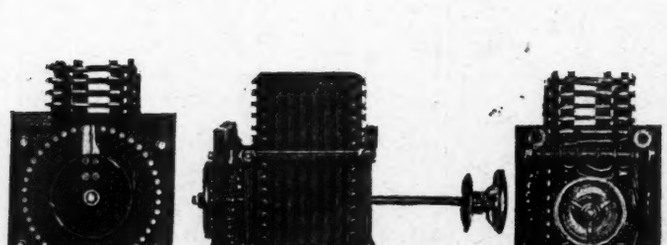
The latest practice in the construction and arrangement of switchboards is illustrated by the following specification representing the leading features of power and traction installations, such as some of the latest designed and fitted by R. W. Blackwell & Co. for municipal use.

TABLE B.—OBLONG FIELD RHEOSTATS, FOR FRONT OR BACK OF BOARD.

Limiting voltage.	Max. amp. 1st step.	Ohms of field to which rheostat is well suited.	Ohms of rheostat.	No. of steps.	Ampere capacity of last step.	Dimensions.
						Inches.
150 volts	8	18·7	22·5	80	3·6	10 × 8
	10	15	18	80	4·5	
	12	12·5	15	80	5·4	
	16	9·4	11·2	80	7·2	
	20	7·5	9	80	9	
	24	6·2	7·5	80	10·8	
	32	4·7	5·6	80	14·4	
	40	3·7	4·5	80	18	
	48	3·1	3·8	80	21·6	
	64	2·3	2·8	80	28·8	
	80	1·9	2·2	80	36	
	100	1·5	1·8	80	45	
	128	1·2	1·4	80	57·6	
300 volts	4	75	90	80	1·8	10 × 8
	5	60	72	80	2·2	
	6	50	60	80	2·7	
	8	37·5	45	80	3·6	
	10	30	36	80	4·5	
	12	25	30	80	5·5	
	16	18·7	22·5	80	7·2	
	20	15	18	80	9·0	
	24	12·5	15	80	11·0	
	32	9·4	11·2	80	14·4	
600 volts	2	300	360	80	·91	10 × 8
	2·5	240	288	80	1·13	
	3	200	240	80	1·36	
	4	150	180	80	1·81	
	5	120	144	80	2·27	
	6	100	120	80	2·72	
	8	75	90	80	3·63	
	10	60	72	80	4·54	
	12	50	60	80	5·45	
	16	37·5	45	80	7·26	
	20	30	36	80	9·09	
	25	24	28·8	80	11·36	
	32	18·75	22·5	80	14·54	



FIGS. 105.



FIGS. 106.

Panels.—Material. Highly polished slate absolutely free from metallic veins; all materials in foundations and backing incombustible; generator and feeder circuits on separate panels; separate panels likewise each for Board of Trade leakage detectors, station lighting and equalising switches, these fixed near generators.

Fittings.—Generator panels. Two main quick-breaking switches connected with two bus bars at back; one magnetic circuit breaker on negative pole between negative switch and bus bar; one dead-beat ammeter with uniform scale from 0 to highest working rating of generator; one rheostat on shunt field sufficient to reduce voltage to prescribed working limits; one shunt of at least 500 ohms resistance; one recording wattmeter; a plug attachment at each terminal for connecting station voltmeter; one lead fuse between positive and negative terminals; alarm connection between circuit breaker and an electric bell; lightning arrester with choking coil connected so that no main short circuit can be produced, and with feeders to the return circuit.

(To be continued.)

ON "EARTHING" AND EARTH CONNECTIONS.

PROBABLY the most important paper read and discussed by municipal electrical engineers for a very long time was that prepared by Mr. Wordingham for the Convention of a few weeks ago. Partly on account of the importance of the paper, and partly because there are other things to be said on the subject, we now turn to the general question, with Mr. Wordingham's views as a text, and it may be that the many subjects brought up at a meeting tend rather to dwarf the value of individual papers, so that the lapse of a week or two clears the air and leaves the subjects standing out bolder than some of them may appear when hurriedly scanned to pick out statements in a paper to criticise.

The real importance of earth connections is now realised by those who have to create and maintain them. The troubles they give rise to are also only too keenly felt by designers and mains superintendents. To maintain a certain portion of a distributing system at earth potential appears a very easy thing on paper and when discussed in the class-room with the aid of the blackboard, but the hypothesis that one is dealing with an enormous sphere of extremely high conductivity is the one thing which the practising engineer knows cannot be sustained. Mr. Wordingham puts it that each branch of the electrical industry has set up in turn a claim to a vested interest in the earth. It would be more accurate to say that each branch claims a vested right to conduct its own business without interference by its neighbours, and what each requires is that "the earth" shall be used by other branches, and not a local area or basin, the potential of which is raised above that of "the earth," and thereby rendered a source of annoyance and inconvenience to everybody else who has any earth connection within the area of disturbance. Mr. Quin put the position very tersely in his paper on "Faults" (M.E.A., 1898), when he said property in "earth" does not exist, but it behoves electric lighting authorities not to interfere with the due and proper working of telephone companies' apparatus. Many hard words have been said as to the National Telephone Company's use of earth returns, but it will be a bad day for the "trouble" man when these earths give place to metallic returns. He suggested that arrangements might be made with the local telephone exchange to allow

connection to be made from the mains through a suitable resistance to the exchange earth, and then from the numbers of the fallen indicators, the position of the telephones could be found on the map and faulty distributors localised. The question is becoming daily more serious, and the interference between different branches of the industry has led to a careful study of the practical effects which follow the attempt to pass large currents through the earth.

The theory of the earth's action as a conductor has received attention over and over again in these columns. Some years ago Mr. Rollo Appleyard contributed some articles on the matter, and readers taking up the subject might find it of interest to peruse them. There is a two-fold aspect, and one approaches the academical treatment at first with some respect, only to find that apparently it does not fit in with the observed facts. The earth, in some text-books, is regarded as forming a large reservoir, and its office is stated to be that of maintaining the potential of a point connected to it at zero. But, says Mr. Wordingham, this explanation is not borne out by experience, as the return currents can actually be detected, and it is more correct and more convenient to regard the earth as a large conductor through which the current actually does flow. This reasoning would, however, rather ignore the analogous case of a large water reservoir, with an inlet and an outlet pipe dipping into it, the example taken by the text-books. Such a water system would *locally* be affected in the same way. If, however, the inlet and outlet be very far removed from one another, then the flow through the aqueous mass could not be traced. Traction systems, and cable networks with faults on, are, so far as the earth itself and as a whole is concerned, purely local, and the conductivity of the sphere or spheroid hardly comes in. This is another way of saying that what the earth lacks in specific conductance it makes up by its enormous mass and the huge area of equi-potential planes it affords. But the difficulty is, as every practical man knows, to get a good and reliable connection with the earth. A few square feet of copper plate in damp soil do not give a true "earth connection"; there may be a local contact, but as often as not the locality is geologically a basin almost insulated electrically from the mass of the globe.* Where the currents dealt with are small, the rise in potential is infinitesimal, but with large currents the local potential may be raised very considerably. Exactly the same argument applies to a water analogy. In short, the employment of the earth as an ordinary conductor where the whole of the outgoing current has to return by it, is restricted to such cases as occur in telegraph and telephone work in which the currents are small, or to such other instances as may permit of the earth connections being made at great distances apart, and then by numerous and large exposed surfaces in the soil.

The second use of earthing, to keep one of a number of conductors at a definite potential not much above that of surrounding non-electrified objects, is only a variant of the first. As Mr. Preece said in his Institution paper (1891), when dealing with this use applied to concentric cables, a concentric main, whether its outer conductor is connected to earth or not, has its potential reduced practically to that of the earth. The use of the earth is imperative to dissipate the static charge and to secure safety. A permanent and efficient earth makes the cable safe to person and dangerous to apparatus only which can be fully protected by fuses. Earth is the electrician's bane, but there may be circumstances under which it may become his antidote. The disturbances which arise from the use of earth for electric lighting purposes were fully dealt with by Mr. Preece in his Institution paper of 1889, and these old papers† contain a great deal which repays study, even at this late date.

Those who were engaged in electrical work 12 or 14 years ago can remember the dread with which the suggestion of Mr. Ferranti (that he believed the trouble of high pressure supply would be got rid of by using concentric mains and earthing the outer conductor) was received. Yet it certainly has been demonstrated since that if the outer be not earthed it will soon naturally reach that condition. Some ten years ago in Rome, where Siemens concentric cable was used, the insulated outer conductor was so frequently pierced that Prof. Mengarini found it necessary to make the outer insulation thicker and better than the inner. History has repeated itself, for the Postmaster-General has proscribed any connection to earth in the case of concentric cables used on rectified arc lighting circuits, and the result is, that punctures of the outer insulation are quite frequent occurrences. The cables of the rectified circuits at Edinburgh suffered from this trouble, and the same story is told elsewhere. An earth connection on the outer in such a case must either be made intentionally, or it will come on naturally within a comparatively short time. In stations with earthed outer high pressure concentric mains, if the earth is made on the switchboard omnibus bar serious troubles have arisen with the machines where they were fitted with double-pole fuses, and the adoption of earths on the armature terminals connected to the outer system has proved a remedy. As Mr. Wordingham puts it, the merit of Mr. Ferranti's original suggestion lay in his foreseeing that, as with both insulated poles, either conductor might have to withstand the full pressure, it was best to at once face the situation, and insulate one of them for the maximum pressure possible and ensure that it alone should be subjected to this pressure by deliberately connecting the other conductor to earth. Mr. Wilkinson in his recent M.E.A. paper records numerous instances where 2,000-volt (concentric outer-earthed) mains have been sawn asunder by careless jointers with the current on, always with disastrous result to the saw but with no inconvenience to the jointer beyond a blinding flash when the saw reached the inner conductor. Probably the only objection to earthing the outer is the necessity then arising for placing all instruments such as ammeters on the inner conductor. Probably Mr. D. F. Andrews was one of the first to earth the outer of a concentric cable, and the difficulty of earth conduction with an uninsulated outer was met later by Mr. Sayer's proposal to put all the insulation on the inner and most of copper in the outer conductor, so as to employ both classes of material to the best advantage.

Earthing on a two-phase system may be either; with two double concentrics, each outer earthed, or a triple with the outermost earthed; while on a three-phase system with star winding the common junction may be so connected, which is a modification of Mr. Mordey's original proposal to earth the centre of the winding of a single-phase transformer supplied by a pair of non-concentric conductors.

Coming to three-wire direct current work, we find Mr. Wordingham saying that the object of earthing one conductor is *not* to secure safety to life, but to enable a consumer to be supplied at such a pressure as will (presumably, formally) comply with the Board of Trade regulations. These regulations are intended to secure safety, and it can hardly be held that 500 volts is a "safe" pressure as regards risk of personal injury. The object seems to be that no one may receive a shock at more than 250 volts, and only recently an accident on the Continent proved that in some cases even lower pressure shocks might prove fatal.

The most important case of earthing conductors is undoubtedly that of tramways, but so many papers have been published, and so much has been said in recent years thereon, that it is hardly necessary to enter on this phase of the subject. Doubtless, as Mr. Wordingham is engaged with the engineers of other departments of the Manchester Corporation in a joint investigation to thrash out what is the maximum difference of potential between the rails and earth at any point that can be allowed, further information of a valuable kind will be presented by him to the engineering profession before very long. The effects of earthing on a three-wire direct current system are of such interest, and have been described so fully in the light of the experience at Manchester, that we may return to the subject again in an early issue.

* A good example was contained in some particulars published some years ago by Mr. Kennelly, and another has been recently given by Prof. Jamieson in his paper on the Cape Town tramway troubles.

† See also Cardew "On Electrical Shocks from Contact with High Pressure Conductors," *Jour. Inst. Elec. Eng.*, April, 1891; Hopkinson "On an Unnoticed Danger in certain Apparatus for Distribution of Electricity," *Phil. Mag.*, September, 1885.

NEW PATENTS AND ABSTRACTS OF PUBLISHED SPECIFICATIONS.

NEW PATENTS, 1900.

Compiled expressly for this Journal by W. P. Thompson & Co. Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, Manchester and Birmingham, to whom all inquiries should be addressed.

13,237. "Improvements in electrical tattooing apparatus, also applicable to stencilling or engraving." A. South. Dated July 23rd.

13,249. "Improvements in and connected with the electrical transmission of images and in the recording of images." W. Friese-Greene. Dated July 23rd.

13,280. "Improvements in arc lamps." J. F. Ackermann. Dated July 23rd. (Complete.)

13,293. "Overhead railway signal by contact alarm." J. E. New. Dated July 24th.

13,356. "Improvements in telephonic relays." W. P. Thompson. (J. Tice, W. G. Urmson, J. W. Parsons, and H. A. Bell, United States.) Dated July 24th. (Complete.)

13,375. "Improvements in or relating to electric ignition plugs." H. F. Atkins. Dated July 25th.

13,385. "Improvements in the method of and means for medically applying electricity." C. T. Driggs. Dated July 25th.

13,401. "An improved electrical converting transformer." C. D. Abel. (La Société Anonyme pour la Transmission de la Force par L'electricité, France.) Dated July 25th.

13,406. "Improvements in or relating to insulating materials." F. A. G. Kirchberg. Dated July 25th.

13,415. "Improvements in and in the manufacture of electric insulator." C. A. Lopez. Dated July 25th. (Complete.)

13,447. "An improved electric tramway system employing alternating currents, preferably polyphase." C. Carew-Gibson. Dated July 26th.

13,448. "Electricity used in tanning." A. T. Wedelin. Dated July 26th.

13,472. "Improvements in telegraphic transmitting, receiving, and translating arrangements." A. Muirhead. Dated July 26th.

13,478. "Improvements in electric motor starting and regulating switches and cut-outs." H. F. Hunt. Dated July 26th.

13,479. "Improvements in and relating to aerial conductors and like apparatus for transmitting and receiving electro-magnetic impulses." J. T. Armstrong and A. Orling. Dated July 26th.

13,482. "Improvements in current collectors for electric traction." E. Bede. Dated July 26th.

13,496. "Improvements in electric switches." W. F. Jones. Dated July 27th.

13,515. "Improvements in or relating to overhead trolley wires or conductors for electric traction, overhead electric cables, or the like." R. Hacking. Dated July 27th.

13,533. "Improvements relating to electric motor vehicles." E. Draullette. Dated July 27th.

13,538. "Improvements in or connected with current arresters." J. G. Lorrain. (P. C. Burns, United States.) Dated July 27th. (Complete.)

13,539. "Improvements in or connected with current arresters and alarms." J. G. Lorrain. (P. C. Burns, United States.) Dated July 27th. (Complete.)

13,540. "Improvements in electric igniting arrangements for internal combustion engines." P. Mauguin. Dated July 27th.

13,573. "Improvements in apparatus for electrically lighting railway trains." E. T. Parker. Dated July 28th.

13,585. "Improvements in electric ignition devices for internal combustion motors." P. Mauguin. Dated July 28th.

13,592. "Improvements in or relating to electric light fittings." H. Hill. Dated July 28th.

13,606. "A new or improved current receiver or trolley for electric railways with overhead current conducting system." G. Nast. Dated July 28th.

ABSTRACTS OF PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson and Co., 322, High Holborn, W.C., and at Liverpool, Manchester, and Birmingham, price, post free, 9d. (in stamps).

1898.

10,608. "Improvements in electrically illuminated buoys." H. H. Lake. (P. C. F. Hoffmann. Dated May 9th, 1898. Relates to electric illumination of buoys. Incandescent lamps are arranged behind transparent or coloured glass plates inserted in the buoy wall or casing and the conducting wires are united to form a cable which leads to a look out station on land. The mooring cable is wound on a submerged drum which can be rotated in either direction by an electro-motor connected with a generator on shore by an electric cable. The buoy can be raised or lowered in the water and can be used for giving various signals to friendly ships in time of war. 1 claim.

10,348. "Improvements in contact devices for sectional cables or conductors for electrically driven vehicles." A. H. Gibbings and J. Kay. Dated September 12th, 1898. Relates to electric railways and tramways with overhead or other conductors. Conductors. To prevent sparking when the trolley passes a section insulator, it lifts a hinged bridge-piece to connect the adjacent sections. A spring pin may serve to open the bridge. 1 claim.

10,399. "Improvement in arc lamps." P. Mersch. Dated September 12th, 1898. In an arc lamp having two regulating solenoids, the movable cores of these are connected by an iron yoke which carries the lower carbon. The solenoids are enclosed by iron tubes and end discs. The object is to avoid external poles on the cores, and render the action of the solenoids on them uniform throughout their movements. The other parts of the lamp may be constructed as described in Specification No. 25,244, A.D. 1897. 2 claims.

10,445. "Improvements in electric batteries." H. Blumenberg, junr. Dated September 13th, 1898. Consists in the use of a solution of ter-sulphate of aluminium as an electrolyte in batteries. In primary batteries, the electrolyte is preferably used with a zinc electrode, and a carbon or lead electrode surrounded with lead peroxide or other metallic peroxide. A sulphate of the metals of the alkalies or of the alkaline earths may be mixed with the aluminium ter-sulphate. In secondary batteries, the electrolyte is a solution of ter-sulphate of aluminium mixed with the bisulphate of potassium, sodium, or ammonium. 4 claims.

10,491. "Improvements in printing telegraphs." J. Kustermann. Dated September 13th, 1898. Relates to means for ensuring the automatic regulation of a number of Hughes printing telegraph apparatus, arranged in series, so that, should any instrument get out of synchronism, no signal can be sent or received until such synchronism is restored. A sectional view of the apparatus shows a V-shaped lever projecting into the path of the rotating contact wiper at a point in the disc where there are no pins. The outer end of the lever plays between two stops connected respectively to the controlling magnet and the printing magnet. The controlling magnet is polarized, and releases its armature when a current flows through its coils. The armature has two extensions, the latter forming a detent for the lever. The first extension engages with a pivoted stop lever, which stops the half-round stud or allows it to pass, according to whether the instruments are in synchronism or not. Each instrument is provided with a throw-over switch and a battery. The switch lever may also have a heel portion playing between stops connected to two of the throw-over switch springs. 2 claims.

10,536. "Improvements in and connected with electric motors partly applicable to dynamos." S. W. Maguay and P. E. Vanderpump. Dated September 14th, 1898. The armature of an electric motor is mounted on a sleeve running on the central spindle to which it transmits motion through speed reducing or increasing gear. The gear wheels are enclosed in a casing, on opening which they can be changed to alter the power. Between the sleeve and the spindle are arranged ball bearings, each consisting of two tapering rings, one of which is adjustable longitudinally to take up wear, the races being of greater width than the balls to permit of this. The carbon brushes are carried by arms on a ring divided into two insulated parts, and they are pressed upon the commutator by springs. Current is supplied to them through rings with which spring plugs on the arms make contact. By means of a toothed segment and pinion actuated by a lever the brushes can be moved over the commutator so as to vary the speed of the motor. The movement of the brush gear may be utilised to reverse the current through the motor, either by a suitable disposition of contacts or by a switch actuated by a pin. When the motor is run from a primary battery, the lever may operate means for raising the zincs out of the liquid or for separating the electrodes in the cells. 6 claims.

10,536. "Improvements in and connected with primary batteries." S. W. Maguay and P. E. Vanderpump. Dated September 14th, 1898. The electrodes are arranged so that the distance between those of opposite polarity may be increased or diminished so as to vary the internal resistance of the cell. One electrode is made with a number of projecting pieces, and is mounted so that it can be raised out of or lowered into correspondingly shaped recesses in the other electrode which is suspended in the cell and provided with an insulated facing and with insulated distance pieces to prevent the two electrodes from coming into actual contact. The electrode is raised or lowered by a toggle pivoted to a frame on the cover, one end of the toggle acting on an insulated rod connected to the electrode while the other end is connected to a shaft, which also serves to actuate a number of toggles connected to other cells. 4 claims.

10,537. "Improvements in dynamo-electric machines." J. Burke. Dated September 14th, 1898. The field magnet frame is constructed in two parts between which is secured a yoke or cradle carrying the bearing boxes for the armature shaft. After removing the upper half of the magnet frame, the armature can be taken out without disturbing the alignment of its bearings. The cradle instead of being bolted between the two halves of the magnet frame, may be supported on lugs cast on the lower half. In the case of a motor, such as may be used for driving cars, the cradle also carries bearings for a countershaft which may be the car axle. 3 claims.

10,555. "Improvements in the bulbs of electric incandescent lamps." C. Bartenstein. Dated September 14th, 1898. Incandescent lamps. Bulbs are made with longitudinal grooves or ridges to diffuse the light. One form described is provided with narrow depressions. 1 claim.

10,621. "Improvements in coin-freed electric meters." C. W. S. Crawley. Dated September 15th, 1898. Relates to coin-freed apparatus for supplying electricity. A pinion nut upon a screw, and in gear with a sleeve pinion, is shifted to the left by the revolution of the pinion derived from the drum after prepayment; it is moved to the right by the revolution of the screw by means of a ratchet-wheel driven by the meter. Any displacement from the extreme right-hand position allows a latch to hold a switch arm, which is pulled into circuit when an arm is pulled out of circuit by a rod. The nut operates an index. Coin action. The coin drops down a shoot into a drum which is divided into quadrants and enclosed by a three-quarter drum, so that, as the coin protrudes, both drums are turned together when the outer one is actuated by a handle. Coin-discharging mechanism. The coins fall in turn from the slots in the drum through a slot in the three-quarter drum. 5 claims.

10,632. "Improvements in and relating to secondary batteries." W. A. Crowdus. Dated September 15th, 1898. The positive electrodes have a sheet of sulphite pulp or paper wrapped longitudinally around them, and against these coverings perforated plates made from wood pulp are placed, and the whole held in place by channelled end pieces of hard rubber. The covering may also be applied to the negative electrodes. The electrodes are preferably of the kind described in Specification No. 1,628, A.D. 1898. 2 claims.

10,636. "Improvements in or connected with the distribution of electricity on the three-wire direct current system." A. B. Blackburn and W. S. Spence. Dated September 15th, 1898. Relates to means for balancing the circuits in three-wire direct current systems. A polyphased choking coil or transformer is connected through collecting-rings with suitable points on the generator winding, and also with the central wire of the system. Arrangements are shown and described of connecting the choking coil. 5 claims.

10,644. "A new system of electric propulsion." W. H. Wheatley. (L. Rosenfeld, C. Zelenay, and J. Dulait.) Dated September 15th, 1898. Relates to a system of electric propulsion by means of alternating currents, applicable to railways, tramways, overhead traction, lifts, &c. In principle, the arrangement consists of an alternating current induction motor of which the inducing and induced elements are each extended into a straight line, so that, instead of a rotary field, a rectilinearly moving field is developed. In the application of the system to the propulsion of a tramway vehicle, the inducing element consists of an extended iron body laid between the rails, and provided with numerous transverse holes or notches, through which the alternating current conductors are wound. The induced element is composed of a number of iron blocks, similarly wound with conductors and suspended from the car by ropes or similar means. Motion is transmitted from the suspended blocks to the car by rollers engaging with pivoted forks which are connected together at their upper ends by a rod. The starting and stopping of the vehicle may be effected either by connecting the induced coils together through a rheostat or by raising and lowering the induced element by means of a lever arrangement. 4 claims.

10,688. "Improvements in connection with the mechanism of electrically illuminated devices for automatically making and breaking electric circuits used in such electrically illuminated devices." J. S. Richardson, S. Jevons, and W. A. Gent. Dated September 16th, 1898. Relates to switching apparatus for illuminated advertisements, &c. The mechanism for making and breaking the contacts is operated by the weighted core of a solenoid. The core is raised, and then falls. In its descent it operates mechanism and also completes the circuit through the solenoid. An appliance is described for an advertisement spelling a word and showing coloured lights at intervals. The double solenoid is fitted with cores carrying a magnet. From it depends a rod fitted with a spring catch adapted to engage with pins on a wheel mounted on a shaft. A fly is driven from this and regulates the speed of descent. Another shaft is coupled to the first shaft, and carries a cam controlling a fork for short circuiting the solenoid at the caps. It also carries a series of cams adapted to operate rods and make or break circuits at mercury cups, and so spelling a word or making contacts for coloured lights. 1 claim.

10,786. "Improvements in incandescent bodies for incandescent electric lamps and in the process for manufacturing the same." C. Kellner. Dated September 17th, 1898. Relates to incandescent lamps. Resistant incandescing bodies are moulded under great pressure from powdered very infusible metals, such as thorium, titanium, chromium, or wolfram, or alloys of such metals, or titanium nitride, and are oxidised on their surfaces by making them incandescent in air, or by immersing them in an oxidising liquid, or by making them anodes in a suitable electrolyte; or the incandescing bodies may be moulded from mixtures of refractory oxides such as thoria which may contain ceria, with very infusible metals or alloys, or with not more than 5 per cent. of graphite such as offers the greatest resistance to attack by a mixture of nitric acid and potassium chlorate. The graphite may be formed by adding cellulose soaked in zinc chloride to a mixture of refractory oxides, heating the body in a vacuum or a neutral gas such as nitrogen, and applying a high potential difference. Leading in wires are moulded into thick ends formed on the incandescent bodies or are fused therein by means of an arc. 6 claims.